WORLD PETROLEUM

NEW YORK AND LONDON

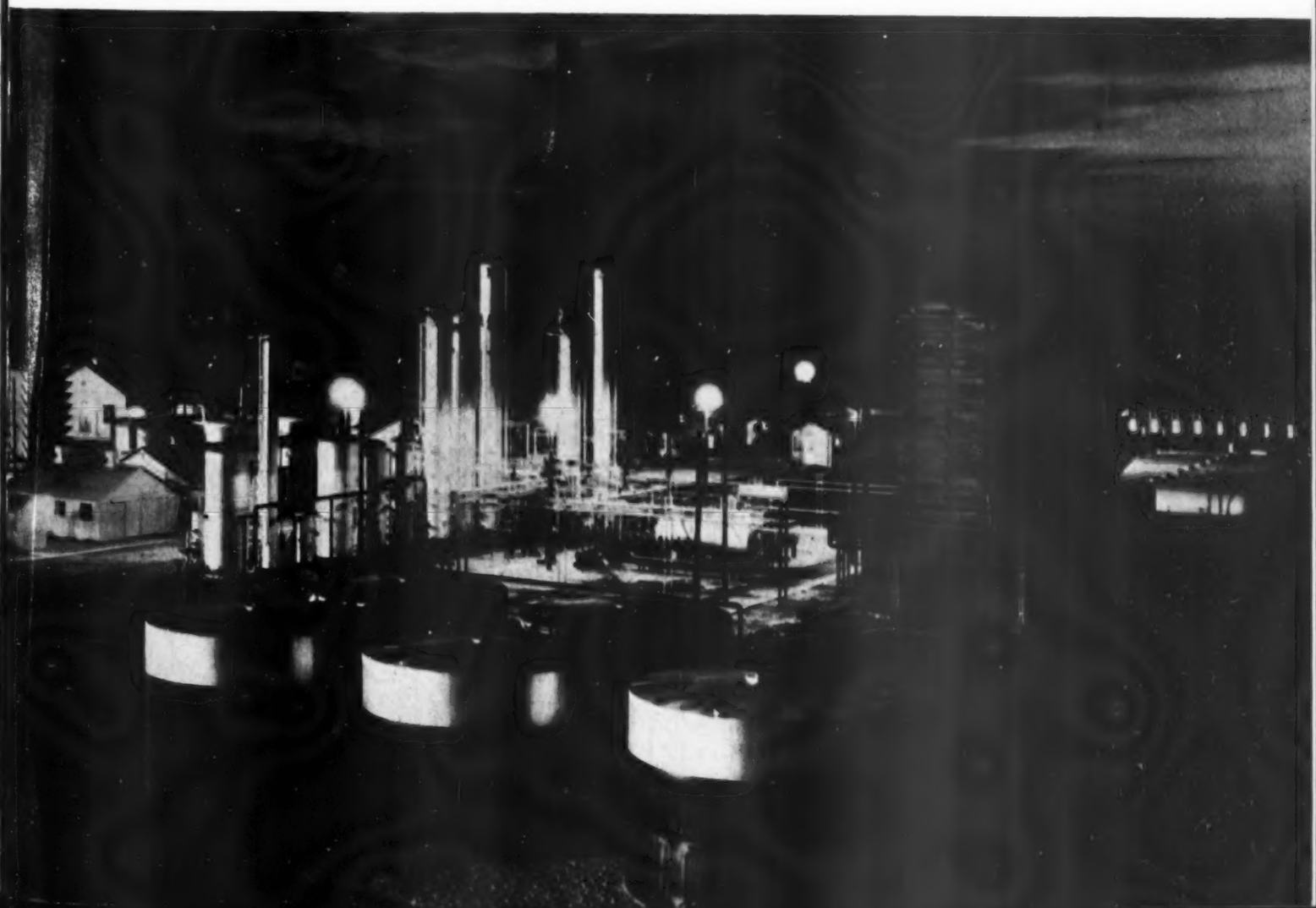
SEPTEMBER 1938

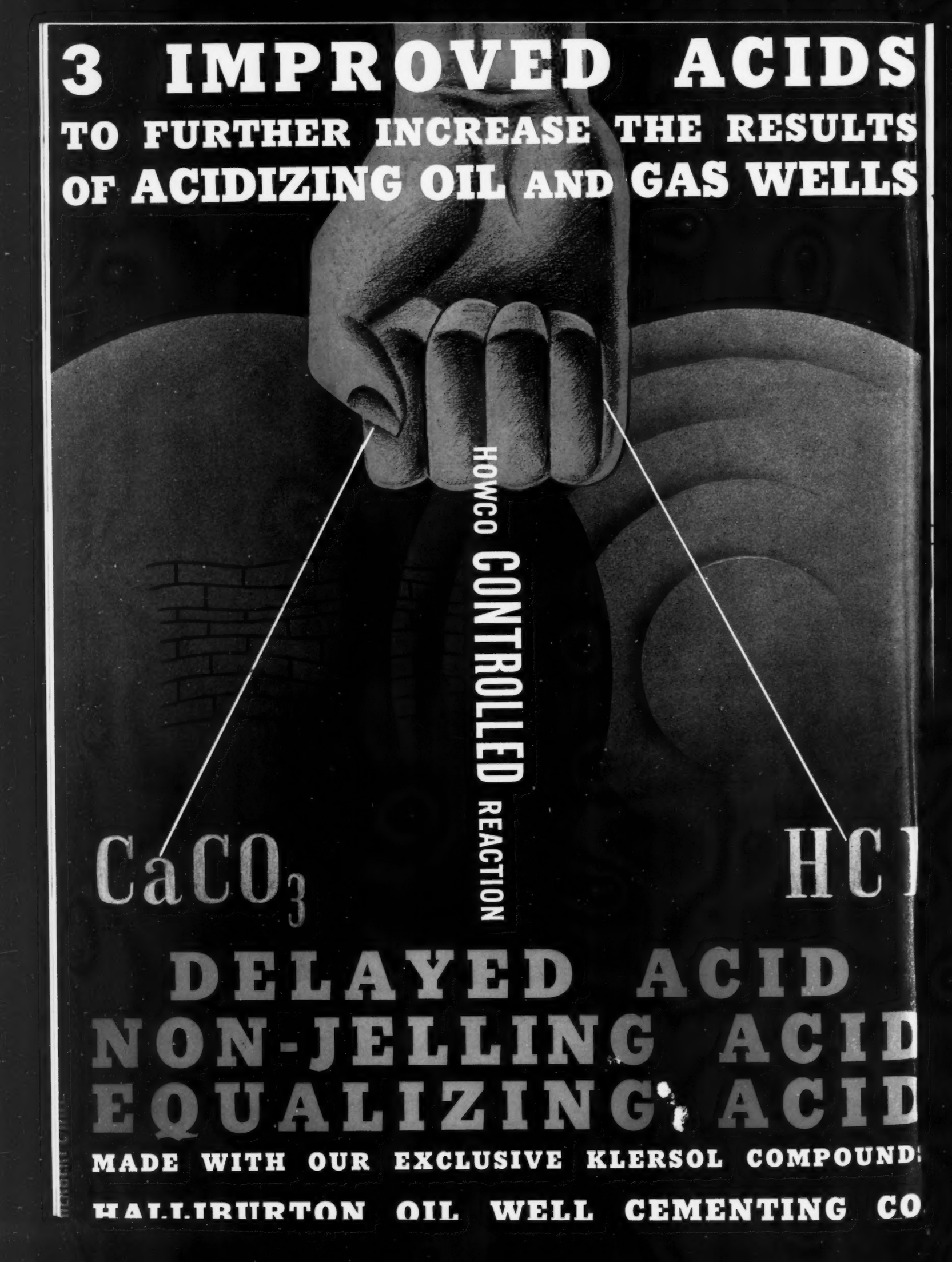
DRILLING EXPANSION IN TRINIDAD

NEW ZEALAND ENTERS PHASE OF ACTIVE OIL SEARCH

TAXATION SAPS FRENCH OIL INDUSTRY

ROCKY MOUNTAIN SURVEY—PART 2

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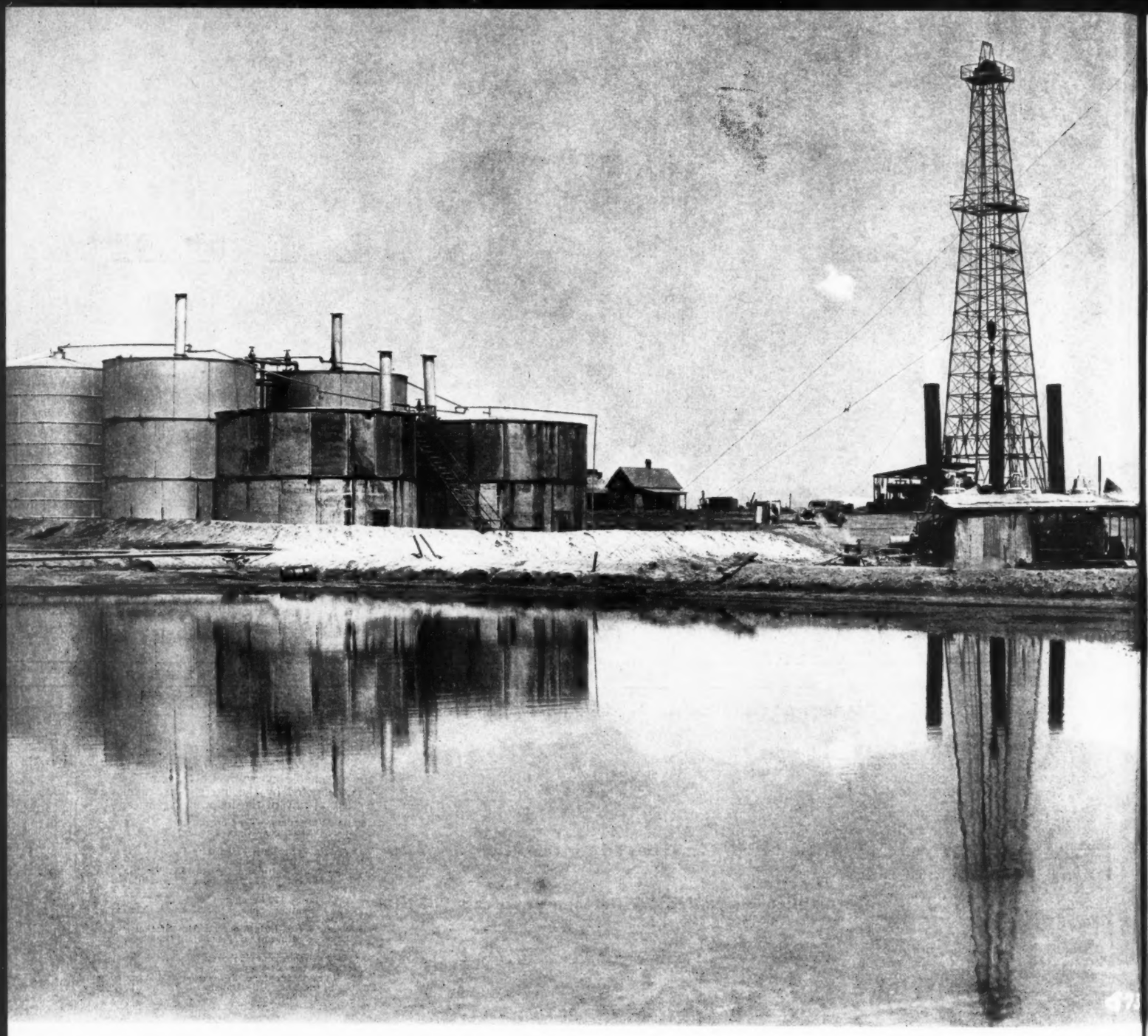


Steam drilling rig operated by Clark Oil Company at Oklahoma City, an extension to State Land No.
Stone Place Addition. Brought in for about 500 bbl. per hour.

EDITORIAL

OIL INDUSTRY NEEDS LOOK TO ITS DEFENSES

IN WASHINGTON it is freely predicted by those who profess to know the inner plans and policies of the federal administration, that during the next two years the U.S. oil industry is to undergo a searching investigation. Its organization, trade methods, the records of its larger units and their relations one to another are to be combed over thoroughly. The extent to which reserves, production, transportation, refining and marketing are controlled by the so-called major companies is to be probed exhaustively and the claim that integrated companies utilize a dominant position in one field of activity to hamper competition in other branches of the industry is to be examined thoroughly.

Petroleum, however, according to these reports, is not to have the unique distinction of being the only recipient of this assiduous attention. A similar course of sprouts is said to be in preparation for steel, for the insurance business and for various other industries in which corporations of large capital conduct broadscale operations. The so-called monopoly inquiry authorized by Congress but dominated by representatives of the executive departments is relied upon to furnish the groundwork for further investigations and possibly for anticorporate suits and legislation.

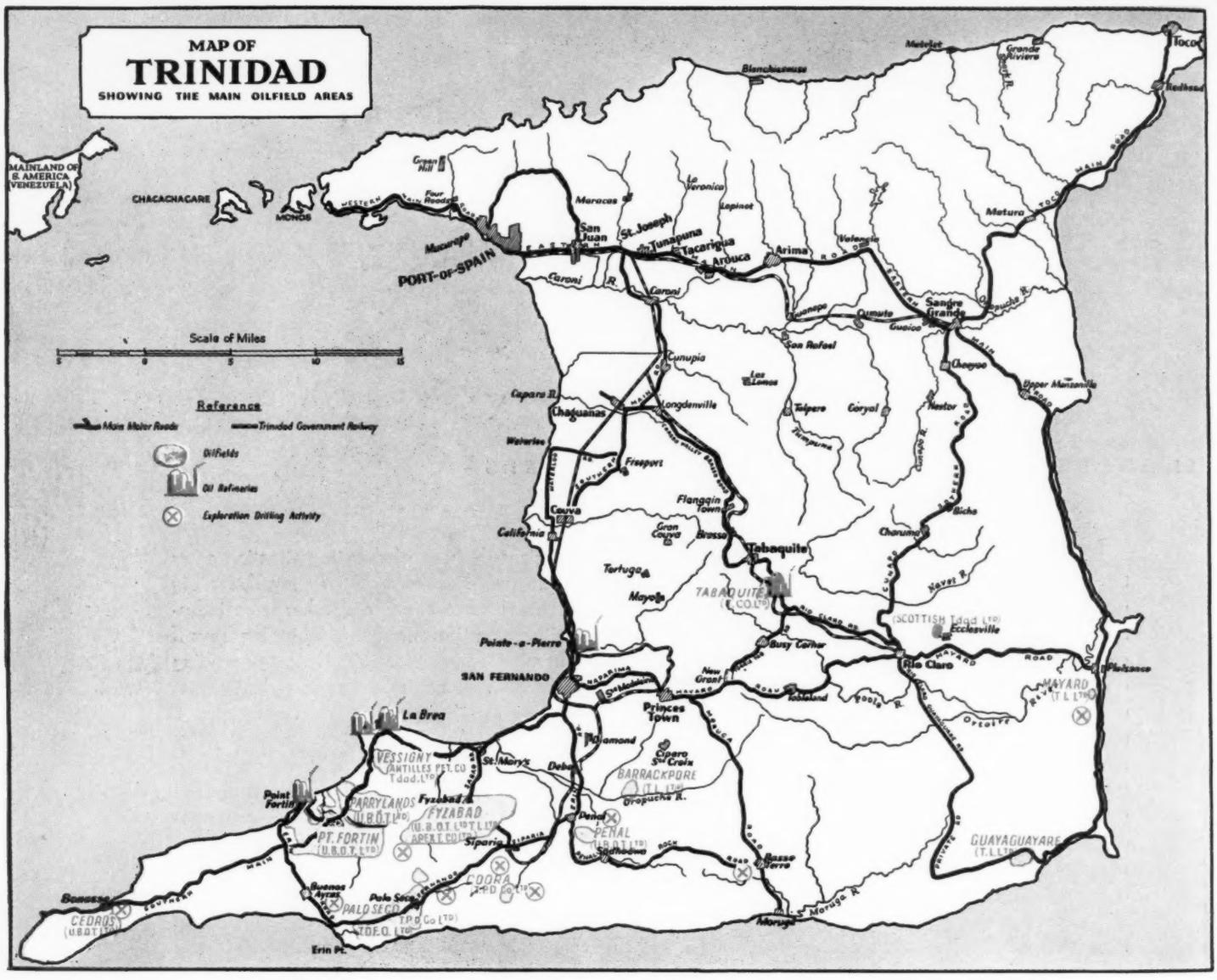
The reason ascribed for projected renewal on a large scale of the drive against big business is an ingenious one. According to the reports already referred to it is based on the possibility that the latest and greatest spending drive may not succeed in reviving industrial activity sufficiently to restore prosperity and reduce unemployment to a point where it will cease to be a serious problem.

In this event, so runs the tale, it will be politically expedient to have a scapegoat available and to divert attention from the failure of this panacea and of others put forward by the administration. Attacks on business and more particularly on large corporations have long been a favorite recourse of politicians desirous of directing attention away from their own mistakes. So, it is alleged, the big oil and steel corporations and other large industrial units are cast for the role of whipping boys if the promises made for the lending-spending program, the crop control program and other pet administration projects fail of realization.

Whether there be much truth or none at all in this particular forecast, there is every reason to believe that the oil industry will be made the object of attempted legislative and executive attacks in the future as it has been in the past. Attempts to force the disintegration of oil companies, to penalize the industry by unfair taxation and to break down the few safeguards that have been erected against waste and destruction undoubtedly will be renewed. Already there are clear indications that opponents of conservation are preparing to conduct a fight against the continuation of this policy in connection with the monopoly investigation that is just getting under way.

Enlisted in this effort are not only those who believe that their own interests would be advanced by the destruction of existing safeguards against waste and confusion, but also another group numerically small but politically influential, who wish to put an end to state regulation as a step toward federal control and operation of the industry. In order to destroy the effectiveness of state regulation they will endeavor to prevent renewal of the interstate compact and to bring about repeal or lapse of the present "hot oil" law.

It will not do to assume that attacks of this sort will fall by their own weight. The oil industry must prepare not only to defend itself, but also to make known its remarkably fine record of public service, of employment and wage increase over the past few years, remembering that in its case eternal vigilance is the price of such liberty as it is permitted to enjoy.



TRINIDAD'S RESERVES Increasing as Result of Intensified Drilling

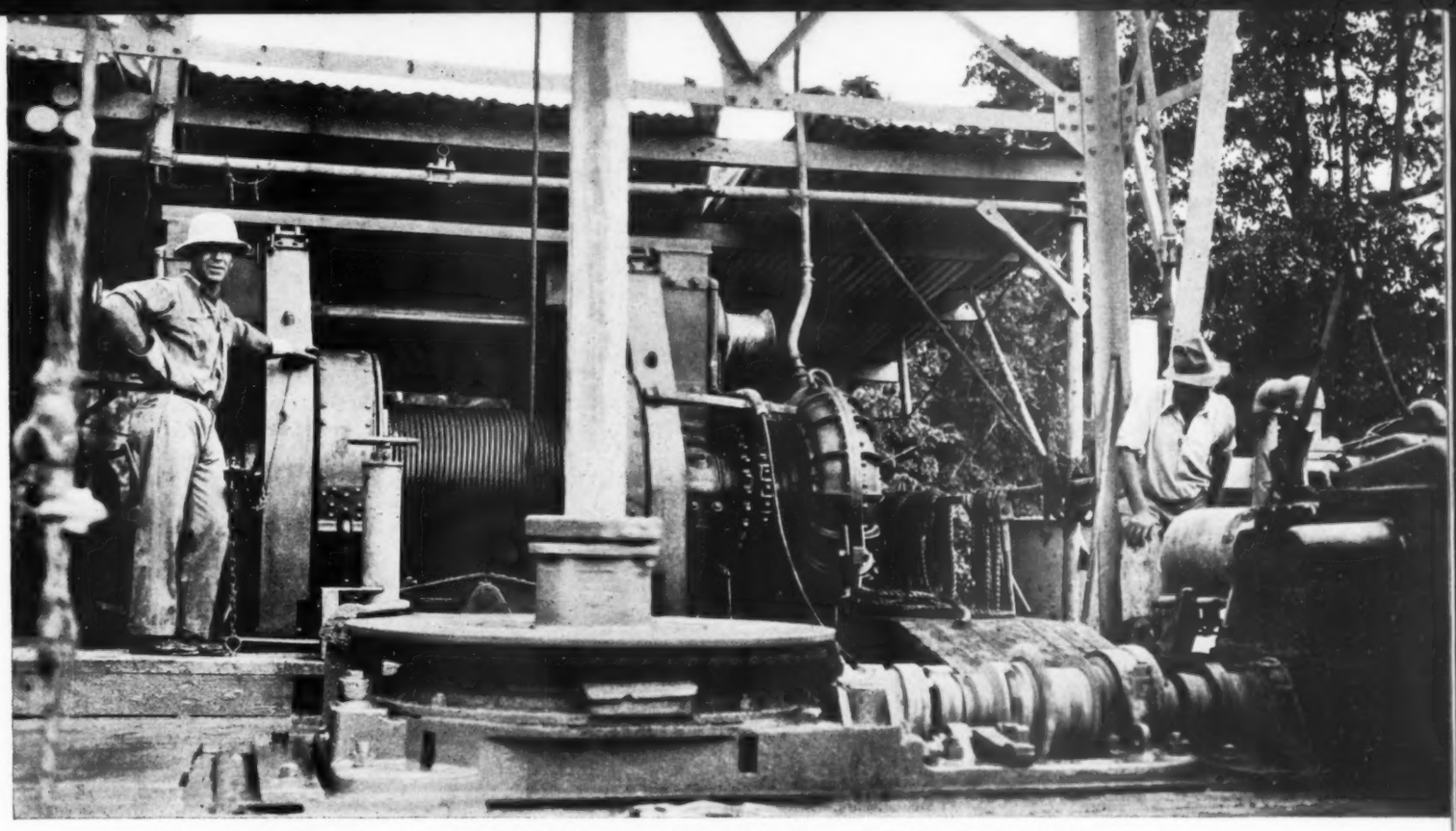
By M. A. ap Rhys Pryce, B.A., M.A.S.M.E., A.M.Inst.P.T.

British Empire's Most Important Oil Producer Quick to Adopt Latest Methods and Equipment—Exploration Is Being Carried Out Over Unknown Areas—Allocation of Submarine Concession.

TRINIDAD, which to most people conjures up a vision of a tropical island with waving palms and glistening beaches and in whose minds its only claim to fame is the existence of the world renowned pitch lake, is rapidly becoming increasingly important in the petroleum world. Although the island produces but a small fraction of the world's petroleum, it is yet the largest single producing unit of the British Empire.

Apart from being the Empire's largest source of oil, its geographical position in relation to Great Britain compared with oil producing territories in the Near or Far East, makes it of considerable strategic importance in the unpleasant but possible event of war in Europe. Whether in peace or war, Great Britain needs to import large quantities of petroleum products and in the event of the latter the problem of bringing cargoes of crude petroleum or petroleum products safely through the Mediterranean by tanker, is likely to give Whitehall and Downing Street food for serious thought. Under these circumstances, the thoughts of the Empire in respect to oil are turning with increasing interest to the Western Hemisphere, notably Canada and Trinidad.

There have been various statements made in the past to the effect that Trinidad



A modern rotary rig in Trinidad with hydromatic brake, direct-driven table and steel rotary hose.

as a whole or certain Trinidad fields in particular had either reached or would shortly reach their peak of production. As in other parts of the world, however, lateral exploration and deeper drilling have proved such prognostications to be erroneous. Such a prophecy was made as far back as 1928 by no less an authority than Sir Thomas Holland, in which he expected Trinidad to reach its peak in 10 years' time, i.e., 1938. That Trinidad has by no means reached its peak is becoming increasingly apparent.

The search for mineral oil in Trinidad appears to have commenced seriously about the year 1905, but the pioneers of that day, of whom Major Randolph Rust is probably the best known, were severely handicapped by lack of adequate equipment, lack of roads and other adverse factors common to virgin tropical territory. The first appreciable production from the island was obtained in 1910 when a total of 105,078 barrels were produced during the year. Since that time the yearly production of the island has steadily increased, with the exception of a small setback during 1933.

That the development throughout the oil industry in Trinidad during recent years has been striking is illustrated by the figures in the accompanying table. In order not to present a too highly colored picture of the increased activity of recent years, it is necessary to go back to the year 1930 prior to the great depression. 1930 was a year of greater activity than any previous year in Trinidad. This was followed by a curtailment of operations during the depression which has again been succeeded by a period of activity greater than ever before. The table illustrates Trinidad's oil history during the past eight years.

Year	Wells drilled or started	Footage Drilled	Production Bbl.
1930	163	372,656	9,418,957
1931	60	218,642	9,743,498
1932	61	173,287	10,126,121
1933	81	235,702	9,561,353
1934	124	351,783	10,894,363
1935	139	436,299	11,671,224
1936	171	594,529	13,237,030
1937	289	911,575	15,502,989

The most striking feature of the above figures is the enormous increase in footage drilled in 1937 compared with 1936. It will be observed that the increase is over 53 percent. These figures are remarkable in that 1937 was a year which saw a serious setback in industrial activity and markets both in Great Britain and the United States, and in which serious labor troubles were experienced in Trinidad. The latter are being dealt with satisfactorily and there is little doubt that the Trinidad oil industry will proceed from strength to greater strength.

Labor employed in the oil and asphalt industries has almost doubled in the past four years. In 1934 the daily average of persons employed in the oil and asphalt industries in the Colony of Trinidad was 5,432 which had risen to an average of 10,084 by 1937. This increase is almost entirely accounted for by the expansion of the petroleum industry. A further comparison may be made between 1936 and 1937 when the number of oilfield operators increased from 16 to 19 and the number of persons employed increased from 7,796 to 10,084.

The increased activity of 1937 has so far been well maintained in 1938; production for the first quarter of this year being 11.15 percent higher than during the same quarter of last year, while production in the month of May, 1938, at 1,481,285 bbl., or approximately 47,900 bbl. per day, is the highest ever recorded in any one month in the Trinidad oil industry.

The leading producing companies in the island are Trinidad Leaseholds Ltd., who market Regent petrol in England; United British Oilfields of Trinidad Ltd., a subsidiary of the Royal Dutch-Shell group; Apex (Trinidad) Oilfields Ltd., who sell their oil to Trinidad Leaseholds for refining and marketing; Trinidad Petroleum Development Company Ltd., a subsidiary of British Controlled Oilfields; Kern Trinidad Oilfields Ltd., subsidiary of the Kern group; Antilles Petroleum Co. (Trinidad) Ltd., a subsidiary of McColl-Frontenac of Montreal; Trinidad Central Oilfields Ltd.; and Trinidad Consolidated Oilfields Ltd.

During the past year and a half all the leading companies have been active both in exploitation and exploration. The greatest single contribution to Trinidad production in recent years is probably that of Trinidad Petroleum Development in the Coora field,

where a production close to 5,000 bbl. a day has been established in less than two years. In view of the fact that in order to obtain the best results from individual wells in Trinidad, it is generally necessary to flow them through very small chokes and initial individual well productions are therefore small, the above is a creditable performance.

In the Fyzabad area, Apex and Trinidad Leaseholds have extended their productive territory both laterally by stepping out and vertically by drilling to deeper horizons. In addition, Trinidad Consolidated, a comparative newcomer to the Trinidad oil industry, has established appreciable production in the Fyzabad area which has helped to swell the volume of oil produced from this, the major structure in Trinidad. According to the 1937 report of the Inspector of Mines and Petroleum Technologist, the Fyzabad structure contributed 53.47 percent of the total Trinidad production for that year compared with 56.70 percent for the previous year. The fall in the proportion of the total Trinidad production contributed by Fyzabad, indicates clearly that exploration work in other areas is producing results.

In addition to the new production in the Coora area referred to above, the Barrackpore area operated by Trinidad Leaseholds has taken a new lease of life through lateral extension of the producing area. U.B.O.T. has improved its production prospects both in the Point Fortin area and in its new field at Penal, while Antilles Petroleum has established oil production in the Pitch Lake area. Interesting wildcat projects are those of U.B.O.T. at Cedros in the southwest of the island and of Trinidad Leaseholds at Mayaro on the east coast.

Other interesting wildcats are being drilled at Erin and in the Siparia, Penal and Moruga areas. The average number of drilling rigs running during 1937 was 36 compared with 32 in 1936.

Trinidad's highest-paid laborers are those engaged in the oil industry.

With the exception of the Tabaquite field of Trinidad Central, which produces a small quantity of light oil from Cretaceous horizons, it may be observed that all producing activity is confined to the southern portion of the island. This is largely due to the fact that the Tertiary sands and rocks from which the bulk of Trinidad oil is currently being produced outcrop frequently all over the south of the island, seepages are numerous, and structures are comparatively easy to find and map. It might be said that the southern half of Trinidad is covered with small anticlines, but these are by no means all productive. Nearly all these anticlines run in a general east-northeast, west-southwest direction. The two main folds, to which the other anticlines can be described as additional wrinkles run, roughly as follows—one through Point Fortin, Fyzabad, Penal and Barrackpore, and the other through Palo Seco, Coora, Moruga and eastwards towards Guayaguayare.

The northern range of hills in Trinidad can be ruled out of oil-bearing prospects in view of the age of the rocks, but there is a considerable area as yet unknown and unexplored in the plains between the southern fringe of the northern range and the proven oil district to the south. This area has been untouched hitherto due to the Tertiary rocks being largely covered by Quaternary alluvial deposits. Seepages are comparatively rare and it is difficult to see and map the structures from surface indications. Oil development therefore has hitherto been primarily confined to the more obvious possibilities of the southern area. The central plains are currently the subject of considerable exploration work, and geophysical parties are engaged in attempting to map the structures underlying the Quaternary deposits. Trinidad Leaseholds and U.B.O.T. are jointly leading in the quest to find oil in the plains and swamps both on the east and west sides of the central hills. It is hoped that success will crown their efforts in the near future. The only commercial production so far obtained on the eastern side of the island is that of Trinidad Leaseholds at Guayaguayare.

In recent months the question of drilling in the sea and Gulf of Paria has been occupying Trinidad oil men's attention to an increasing degree. Allocation of the marine concessions to a company or companies is a matter at the discretion of the Colonial Government and in view of Trinidad's strategic importance, is receiving careful consideration by both the Home and Trinidad Governments. There is little doubt that several known shore structures extend into the Gulf of Paria and marine production in Trinidad is likely to be an accomplished fact before long.

The island possesses two major refineries, one at Pointe-a-Pierre operated by Trinidad Leaseholds Limited and one at Point Fortin operated by United British. These two refineries between them handle the bulk of the island's crude.

DRILLING

Formations drilled in Trinidad are mostly soft shales and sands with occasional bands of hard rock or sandstones, known locally as shells. The formations in themselves are comparatively easy to drill, although there

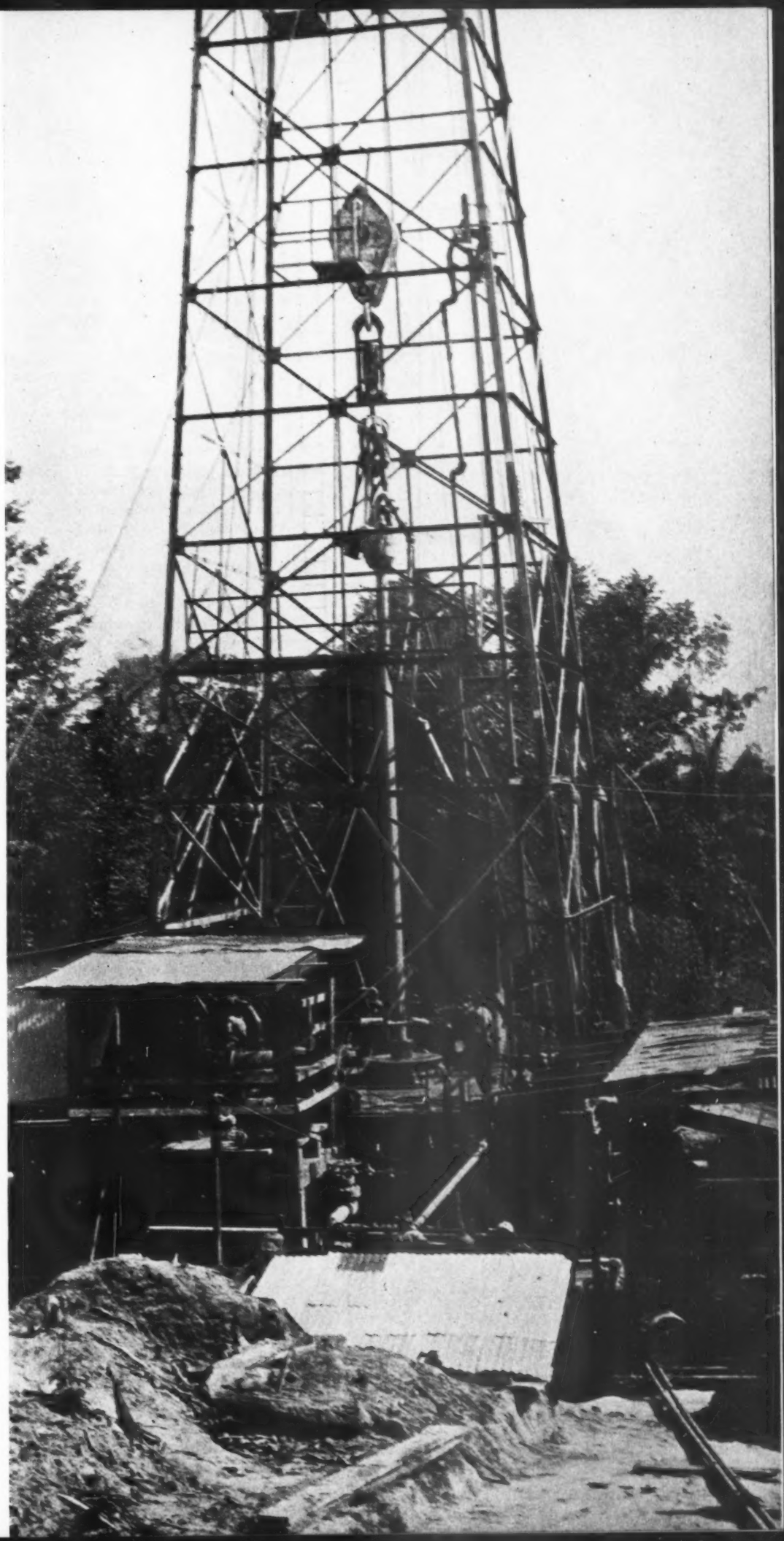
are two serious adverse factors frequently affecting Trinidad drilling conditions. These are: firstly, the abnormal reservoir pressures encountered; secondly, the presence of soft, sticky shales which unless carefully handled by proper technique will tend to creep into the hole and stick the drill pipe or necessitate redrilling a portion of the hole several times over.

It is an interesting fact that the most successful solution of both these problems is identical, i.e., the use of heavy mud and large circulating volumes. Heavy mud in Trinidad is used both to control high pressures and to keep loose shales in place. The soft shale problem is frequently further aggravated by the presence of dry gas within them, which intensifies their movement if they are once allowed to start creeping. It may be remarked that in general the soft, sticky shales which cause drilling troubles in Trinidad are not true heaving shales and do not contain any high percentage of bentonite.

Reservoir pressures in Trinidad are frequently found to be considerably in excess of the equivalent hydrostatic head for the given depth, though there have been one or two recorded cases of subnormal reservoir pressures appreciably below expectation.

The explanation of the abnormal pressures encountered in Trinidad, would appear to be either a geological uplift of the producing horizons from a greater original depth or the erosion of overlying strata; while an alternative explanation is the theory that the oil has been injected into the producing sands under great pressure from deeper horizons via faults or dykes. Trinidad operators frequently use mud weighing 125 lb. per cu. ft., i.e. twice as heavy as water, and at the same time have acquired considerable skill in keeping down the viscosity of such heavy mud. There have been several recorded cases of mud weighing as much as 140 lb. per cu. ft. being used in actual practice. The necessity for this is not surprising when it is appreciated that pressures approximating 3,000 lb. per sq. in. have been encountered at depths of not more than 3,000 ft. in contrast to normal expectation of pressures in the neighborhood of 1,500 lb. per sq. in. at this depth.

Various attempts have been made from time to time to drill into these high pressure zones with pressure drilling equipment, but these have not so far met with much success and have not been persevered with. Pressure drilling, although successful in other parts of the world in dealing with normal pressures and particularly successful with subnormal reservoir pressures, does not yet appear to be able to contend successfully with Trinidad conditions.



Rotary rig operating in the Trinidad jungle.

High-pressure Christmas tree complete with direct-reading and recording pressure gauges.

Trinidad, generally follows United States drilling practice though, like most other areas, it cannot help but be slightly behind the latest U. S. practice. Steam pressures used are still comparatively low, in the neighborhood of 225 lb. per sq. in. although an increasing number of 250 and 300 lb. boilers are being imported.

In other respects drilling equipment is well up-to-date compared with American practice, unitary draw works being used throughout by all the major companies. The problem of transporting heavy unitary draw works and kindred modern drilling equipment over the narrow roads and light weight bridges of Trinidad has forced operators to use the very lightest possible equipment. One light-weight draw works capable of drilling to 6,000 or 7,000 ft. was developed by a major supply company in the United States largely for this particular work, and the most recent information to hand is that more of this type have been sold outside the United States than within its borders. The difficulties of transport have been one of the major factors adversely affecting drilling progress in Trinidad, particularly in respect to the use of larger and more powerful pumps.

In view of the current exploration activity, the advantages of Diesel drilling are being appreciated, particularly in view of the difficulties of water supply in some of the exploration areas, while at the same time the cost of hauling fuel to boilers at wildcat wells is appreciable. Some of the leading companies in the island now use Diesel rigs of the latest type for exploration work and have gone a step further than current practice in the United States by introducing a hydraulic coupling between the Diesel engine and the draw works.

In principle the practice of connecting anywhere from 400 to 600 horsepower from internal combustion engines direct to a standard jaw clutch draw works does not appear sound from an engineering standpoint, even though a friction reversing clutch is used, and of course does not begin to approach the flexibility of steam power. Delicate fishing jobs are almost impossible with such a combination. However, by the introduction of the hydraulic coupling between the draw works and power plant it is possible to approach the flexibility of steam.

Drilling speeds are generally below average results achieved in the United States but this is largely due to the difficulty of installing and transporting sufficiently large pumps and to the fact that as a general rule the heavy mud required increases circulating pressures to such an extent that circulating volumes are appreciably reduced and hence drilling speed reduced. The formations, which, as noted, are mostly soft shales and unconsolidated sands, are fairly easily drilled with a drag bit, though it is occasionally necessary to use a rock bit on the local shells.

Drilling depths in Trinidad are gradually increasing, although the average depth per well drilled in 1937 was 300 ft. less than 1936 due to extensive shallow exploitation programs in certain fields. At the end of 1937 the deepest well in the Colony was 9,039 ft. while there were three wells over 8,000 ft. deep and 26 over 6,000 ft. deep. The bulk of the production of the island, however, still comes from comparatively shallow horizons in the neighborhood of 4,000 ft. Of the 911,575 ft. drilled during 1937, over 850,000 ft. were surveyed by electrical methods.

PRODUCTION

Trinidad is a land of many producing horizons, of which the three main ones are termed the Morugas, the Forest sands and the Cruse, the last-named being the oldest geologically. No individual sands have been identified in the Morugas as yet, but the Forest series is divided into four main horizons, and the Cruse has been so far separated into three main horizons. In the Fyzabad district the majority of these horizons are present but are by no means oil-bearing in every well.

Owing to the high reservoir pressures prevailing throughout Trinidad, and the fact that most of the operators appreciate the necessity for conserving reservoir pressure and the attendant gas in solution with the oil which has yet to be produced, the bulk of Trinidad production is still flowing. It is common practice to choke wells down to as low as five or six thirty-seconds of an inch opening as soon as they are mud-free.

This practice not only has the technical advantage of conserving the reservoir pressure but also the mechanical one of holding back the unconsolidated sands from which most of the production comes, thereby preserving the mechanical condition of the well. These small chokes naturally preclude spectacular individual well productions, but the practice has been proved to be sound and advantageous in the long run and has been universally adopted.

Prior to the application of engineering and scientific principles to production practice, Trinidad, like many other oil countries, tried flowing its wells wide open in order to obtain as much oil as possible in the shortest possible time. This occasionally resulted in initial productions as high as 30,000 bbl. per day, but almost invariably resulted in the well being sanded up in the first month with collapsed oil string and cut-out surface fittings, after which the most that subsequently could be obtained from it was a few barrels per day on the pump.

At least two oil companies are currently returning gas to the ground, the lead having been given by Trinidad Leaseholds. Whatever may be the pros and cons of repressuring or pressure maintenance the contention is unanswerable that it is economically sound in the long run to put gas back in the ground rather than blow it into the air.

Electric coring has played a large part in recent Trinidad oil developments.

STORM Over French Oil Taxes

By Dr. O. W. Willcox

As is now almost universally the case when a government finds itself in need of more cash, the French Ministry of Finance has recently promulgated new taxes on petroleum products (decree of June 17th, 1938).

The circumstances which led the government to impose these new burdens on the already heavily loaded French petroleum trade had their origin primarily in the troubles of the French farmers, on whom nature has saddled a wheat crop that is far in excess of the domestic consumption of this cereal.

Then again, the Alcohol Administration is in difficulties. Past surpluses of agricultural products have been converted into alcohol for enforced mixture with gasoline; in this business the Alcohol Administration had incurred a large deficit which now has to be made good. Finally, it was necessary to find more money to alleviate distress among the agricultural laborers.

To meet these needs the law of June 17th imposed the following oil taxes:

1. A special surtax of Fr. 4.75 per hectoliter on all the principal petroleum products; this tax is labled "equalization tax for meeting the deficit in the alcohol srvice" and is expected to bring in Fr. 200,000,000.

2. A special surtax of Fr. 4.75 per hectoliter on all oil products, to be levied each year for a period of ten years. This tax is to cover the cost of increasing the production of fuel alcohol "to the extent judged necessary;" the annual proceeds are also estimated at Fr. 200,000,000.

3. An increase in the tariff on all imported petroleum products. The proceeds of these increased duties are earmarked for "allotments to agricultural families."

On the basis of 1937 consumption figures this tax will bring in Fr. 400,000,000. Altogether new taxes amount to an annual burden of Fr. 800,000,000 on the petroleum trade.

The new oil taxes immediately aroused vigorous objection from oil men, who have exposed the shallowness of the government's arguments in justification of them and have scored the authorities for failure to take into consideration other and more sensible ways of meeting the situation.

In the first place, no logic or equity is seen in the proposal to saddle allocations to families of agricultural laborers on the automobilists instead of making them a charge on the agricultural industries, as is done in other divisions of the national economy, or on the general revenue of the country. It is freely stated that if the French parliament had been exercising its normal functions this iniquity would not have been perpetrated.

In the second place, the hollowness of the pretext that a heavy equalization tax is needed for meeting the deficit in the alcohol service is evident from the simple fact that the revenue from the tax will be far larger than the actual amount of the deficit. Actually, the assigned reason is a thinly disguised cloak for a project to wring more money out of the automobilists for unspecified purposes.

The heaviest fire of the critics is directed at the principle and method of unloading the difficulties of the wheat farmers on the oil industry. The government is charged with failure to comprehend elementary facts in national economy.

The Finance Minister attempts to justify an increase in the production of alcohol motor fuel on the ground "that it will lighten the burden on foreign exchange due to constantly increasing petroleum imports, and that it will increase the national security in time of war in proportion as the necessity for imports of foreign fuel is reduced. On the other hand, it will offer the nation's farmers the possiblity of developing certain industrial crops and will eliminate the excess supply of certain agricultural products."

These are stock arguments that have been advanced in many other countries to justify the creation of an alcohol fuel industry. They have often been shown to be fallacious and their fallacy in this case has been luminously demonstrated anew by General Serrigny, president of the Chambre Syndicale de l'Industrie du Pétrole.

As regards lightening the burden on foreign exchange, it is pointed out that the distillation of alcohol requires coal; France has to import much coal, as the product of French coal mines is inadequate for the country's needs; a simple calculation shows that the cost of the coal required by the alcohol distilleries exceeds the value of the imported gasoline which the alcohol would displace.

As regards the claim that production of alcohol would reduce the amount of petroleum fuel that would need to be imported in time of war, the government has overlooked the fact that in war time every drop of available alcohol will be needed for the manufacture of explosives, leaving none for fuel. The best assurance of an adequate supply of oil in a war of any importance will be the establishment and maintenance of commercial relations with the great international oil companies. To create a source of supply in peace times that would have to be renounced in time of war would weaken these vital connections.

The argument that promotion of alcohol production would enable the farmers to create new agricultural industries or to extend existing ones is insidiously shallow. In a country where agriculture has been so fully developed as in France, any extension of one crop must necessarily be at the expense of some other. It is now proposed to stimulate alcohol production, which will lead to an increase in the area devoted to wheat, sugar beets and potatoes. Meanwhile there is a shortage of other crops, for example, oats, of which the French had to import 780,000 quintals in 1937; more alcohol will simply mean more imports of oats, etc. The argument that production of more alcohol fuel will lighten the burden on foreign exchange again breaks down.

There are yet other counts in the indictment of the government's loose manner of economic thinking. What the new alcohol scheme amounts to is that the present high domestic price of wheat will be maintained on every kilogram of the grain that the French consumer can be induced to buy. The surplus will be paid for at the ruling price on the export market. The critics blandly ask why the surplus is not disposed of by exporting it. It makes absolutely no difference to the farmer whether the export value of his surplus wheat is paid for by the foreign consumers or by the government, except in so far as the farmer himself is a taxpayer, but it does make a notable difference in the national economy. The surplus, estimated at well above 2,000,000 tons, will bring in no small amount of foreign cash or credit with which to finance the importation of necessary raw materials, including petroleum and coal. If the government is really anxious to lighten the burden on foreign exchange, it is here overlooking or ignoring an opportunity not only to diminish the outgoing debits, but to swell the incoming credits.

Not the least questionable feature of the new French petroleum tax law is the 10-year term assigned to the surtax that is to provide means for converting surplus farm products into alcohol. There might be some reason for this surtax in years of bumper crops, but none at all in years of short harvests; no provision is made for proportioning the tax to the size of crops.

The main objection to the whole proceeding is the practical certainty that it will decrease both the production of automobiles and consumption of gasoline in France.

View of Taranaki country looking south towards Mt. Egmont. The country is volcanic and conglomerate.

© J. Austin

NEW ZEALAND Enters Phase of Active Oil Search

Following 52 Years of Desultory Drilling and Small Production, Recent Petroleum Law Has Led to Interest and Activity by International Oil Companies.

GEOLOGICALLY, many parts of New Zealand offer fair prospects of oil in commercial quantities. Long before the first European settlement the Maoris noticed oil from seepages floating on the surface of the sea at New Plymouth near the volcanic plugs known as the Sugar Loaves, and even today there are several seepages to be found on both the North and South islands. New Zealand's first well was drilled in 1866 and small quantities of oil have been produced from a few wells drilled near the Sugar Loaves. Twelve years ago Frederick G. Clapp, the well-known New York geologist, who lately has been prominently identified with exploration in Iran and Afghanistan, visited the country and reported favorably on the oil possibilities of the Taranaki district regardless of the many drilling failures up to that time.

Results up to the present time, while worthy of recording as a guide to the possibilities of commercial production, are not likely to have much tangible bearing on near future possibilities because of the great strides in geophysical and drilling techniques made since drilling was first carried on in New Zealand, especially as five of the world's largest and most experienced oil producing companies have recently became interested through affiliated companies. In the Kotuku area of South Island, over 40 test wells have been drilled, while on North Island there are 32 non-productive wells in the Gisborne district, and in the Moturoa field at New Plymouth there are about 15 wells apart from seven in other parts of the Taranaki province. Only three are producing. Gisborne No. 2 well at Mangaone went to a depth of 3,900 ft. in 1930, contrasting with the shallower drilling in most of the Gisborne area, where only ten holes are over 1,000 ft. Taranaki Oilfields Ltd. sank a 3,000 ft. well on New Plymouth beach, and drilled another to 5,010 ft. at Tarata, 20 miles inland in a northeasterly direction but without any known results. Blenheim Oil Reclamation Company Ltd. drilled its No. 1 well to 2,210 ft. Two shallow horizons were found, the other being at 2,170 ft. During the first 15 years, 3,000 bbl. of oil were recovered from this well. It was drilled to 5,000 ft. and has been bubbling gas for 22 years since the drilling operations ceased. Blenheim No. 2 well, 66 ft. away, averaged 33 bbl. of oil daily for the first 11 days in April, 1931, after having blown wild twice. Production in 1936 from the Moturoa coastal field aggregated 4,546 bbl., while in the years between 1866 and 1931 New Zealand produced about 60,000 bbl. Moturoa Oilfields Ltd. reported to the last issue of the World Petroleum Directory that its output in 1935 was 6,024 bbl. During 1936 the only drilling for oil in New Zealand was carried out by Maoriland Oilfields Ltd. at Kotuku, where five shallow holes were put down. So far as can be ascertained, production in 1937 was approximately the same as the previous year. No new wells were drilled.

For many years Vacuum Oil Company Pty., Ltd., has shown interest in exploring for oil in New Zealand and Australia, and first sent the geologist, Ben Belt, to New Zealand in 1924 and followed him with Dr. Jablonski in 1930. In 1933 and 1934 Vacuum Oil joined forces with Standard Oil Company of California in carrying out further surveys in Gisborne district in collaboration with four existing New Zealand companies that owned prospecting rights. Four geologists and their staffs were working for two years.

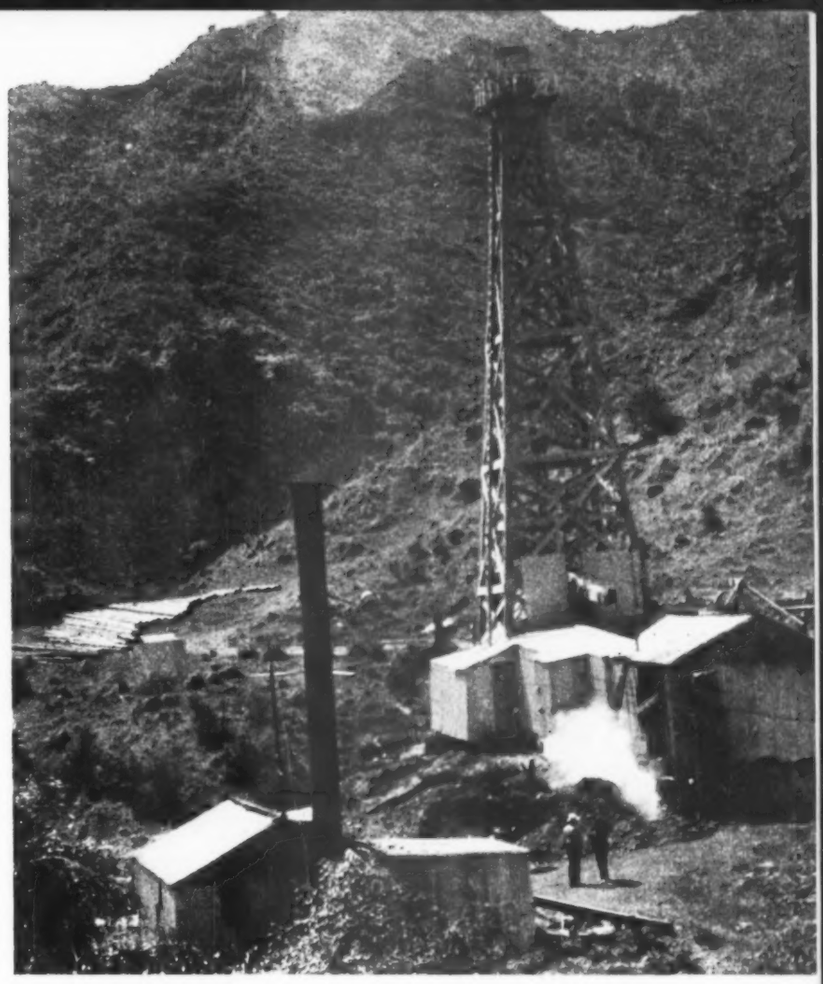
In 1937 the government of New Zealand brought into effect a new petroleum act, and by midsummer the government had received applications for 72 prospecting

licenses from companies affiliated with Standard-Vacuum, California-Texas, and Shell. On May 17 of 1938, the New Zealand Petroleum Company Ltd. was formed are Wellington.

One-third of the shares of this company are owned by Shale Oil Investigations Pty., Ltd., representing local interests. One-third is owned by California-Texas Investments Ltd. The remainder is owned by Vacuum Oil Co. Pty. Ltd. in turn owned by Standard- Vacuum Oil Company Ltd. (Jersey-Standard and Socony-Vacuum). The initial capital is £250,000 in £1 shares. In addition to owning 400 out of the 600 "A" shares, the American interests own 250,000 "B" shares, but only the "A" shares are entitled to participate in the profits. The directors of the company are as follows:

Sir Colin Fraser, Chairman Sir Walter Massy-Greene, K.C.M.G., Vice-Chairman	Representing Shale Oil Investigations Ltd.
Hugh Hamilton Wesley A. Ince	Representing Vacuum Oil Company Pty. Ltd.
A. K. S. MacKenzie Hubert H. Sterling	Representing California-Texas Investments Ltd

New Zealand Petroleum Company has been granted a licenses for 2,800 squares miles in the North Island and 80 square miles in the South Island. Under the new oil law of 1937, only 200 square miles for exploration and 100 square miles for exploitation may be granted in one license, but any number of licenses can be secured. Shell, for instance, applied for a total of 10,120 square miles. The New Zealand government has not been slow to follow the British government's oil laws whereby all petroleum below the ground belongs to the Crown. Granting of licenses to produce oil is under the authority of the Ministry of Mines. Prospecting licenses cover a period of five years and £1,000 per license must be deposited as security. There is an annual fee of five shillings per square mile. When oil is found, the maximum period of the mining lease is 42 years, but extensions may be obtained making a total of 63 years. For each square mile of mining lease £20 has to be deposited as security and an annual fee of £10 per square mile paid. There is a royalty of not less than 5 percent to be paid the Crown on all oil produced. When the output amounts to commercial production, a refinery must be built. This brings to mind the early days in exploring for oil in New Zealand when optimism was so great that a refinery was erected. It was later dismantled and the equipment shipped to Iran.



No. 2 well on a site at Mangaone, north of Hawkes Bay. The cable tool rig has been replaced by an Emsco rotary. It was drilled to 3,900 ft. and proved dry.

Pumping oil from an 83 ft. shaft at Kotuku. N.Z., in 1910.

New Zealand Petroleum has received in the Gisborne area, where its first well will be located, a complete new rotary outfit with a 136-ft. derrick capable of drilling to 8,000 ft. J. C. Stout, general manager, and a drilling crew are on the ground. Geological parties are exploring the North Island under the direction of L. B. Kellum, chief geologist. Geophysical and gravimeter crews are being sent to New Zealand and will be followed by a seismic crew.

Another company, not yet mentioned, also has been operating in New Zealand, namely, Coal Oil (N.Z.) Ltd., Melbourne, Australia. It was established with a capital of £75,000 and started drilling early in 1930 at Omata on a site selected by the Elbof geophysical method. A rotary rig operated by American drillers was used. Owing to the structure being of alternating boulder, mudstone, sandstone and clay, much grief was encountered through lost tools and broken bits in going down to 3,000 ft.

Another Australian company, New Plymouth (N.Z.) Oil Fields Ltd. of Sydney, which was formed with a capital of £100,000, commenced to drill in New Zealand in December, 1930, and went down to about 2,500 ft. No report as to its success is available other than that gas showings were frequently met in passing through the 960-ft. level. This well was located near the base of the volcanic plug and was considered to have the best chance of any well drilled up to that time. At one time Anglo-Iranian Oil Company—then Anglo-Persian Oil Company—registered a company at Wellington with a nominal capital with a view to acquiring exploratory and drilling rights for all New Zealand but the law, as then existing, made this impracticable.

Last year, the Department of Scientific and Industrial Research, Wellington, published a bulletin on petroleum in New Zealand prepared by J. Henderson, director of its geological survey branch, issuing the same under the authority of the Hon. D. G. Sullivan, Minister. In addition to a general discussion of the geological phases of the two islands, Mr. Henderson covered the oil

possibilities of the various parts of the country in detail and refers to various places where oil indications and seepages are to be found.

Regarding exploration, Mr. Henderson states that the numerous expanses of oil and combustible gas in the Waipiro-Gisborne-Waitangi area will always excite interest, and that the features of geological history, sequence, and structure are both favorable and unfavorable.

The thousand square miles of heavy country east of the foothills of the highlands and the coast between Waipiro Bay and Gisborne, in his view, seem the most likely petroliferous area in the Raukumura district. Outcrops of sandstone are known to contain oil and in the Waiapu area the late Cretaceous sandstone over hundreds of square miles smells strongly of oil when freshly broken. The many thousands of feet of middle and late Tertiary mudstones and argillaceous silty sandstones would be excellent cover for any oil-pool and they themselves are possible source rocks. Dealing with the Taranaki district, Mr. Henderson points out that the bulk of the oil produced to date has come from a depth between 2,000 and 3,000 ft. Shows of oil and gas were gotten nearly to the greatest depth attained, namely, 5,726 ft. Oil horizons are indefinite. The known oil is found southeast of the great igneous mass of which Paritutu and the Sugar Loaves are the remnants.

The petroleum seepages are on the upslope side of the contact of the igneous rock with the strata of the Taranaki sedimentary monocline, and may be escaping from a trap structure on the seaward side of the Sugar Loaves. The overflow from the oil-pool in the hypothetical trap structure fed, and perhaps is still feeding, the oil-sand tapped by the wells at New Plymouth. On this interpretation a well on the shore west of Paritutu drilled through its projecting base of igneous rock into the sediments below might give good results.

Covering the Kotuku district in the Southern island, Mr. Henderson refers to the well-known seepage about 15 miles southeast from Greymouth where the region is structurally analogous with West Auckland and Taranaki. This seepage is the most prolific in New Zealand and saturates with oil several acres of gravel and moraine which mask the Tertiary beds. Recent geophysical work suggests that the oil reaches the surface on the upthrow side of a fault or sharp warp that strikes northwest and depresses the country on its southwest side about 200 ft.

The thick dark calcareous Kaiata mudstones (2,000 to 3,000 ft.) overlying the 4,000 ft. or more of late Cretaceous and early Tertiary coal-measures is a much more likely source of petroleum than the latter, which consists of terrestrial beds. Still higher in the sequence are middle Tertiary coal-measures, mudstones, sandstones, and limestones, and late Tertiary mudstones, sandstones, and conglomerates—in all close to 3,000 ft. thick. The limestone has been considered as a storage bed and is itself a possible source of oil, for at several localities the rock when freshly broken yields an evanescent smell of oil.

At Kotuku four bores at least, and probably six, have penetrated the altered old rocks below the Tertiary cover. Late Cretaceous and early Tertiary beds are absent, and if the oil is derived from these beds and is migrating along the contact with the old rocks one would expect petroleum in the jointed limestone and the porous underlying deposits. These, however, contain but a trace of oil, and much the greatest quantity is found within 150 ft. of the surface, hundreds of feet above the limestone horizon which at the seepage is about 500 ft. in depth. On this evidence, the oil is derived from Pliocene mudstone and carbonaceous shale. In this region the older Tertiary strata have nowhere been tested by a bore in a structure that is suitable for the accumulation of petroleum. Such favorable structures may well exist in the large area of the graben covered with gravel and moraine.

There were at least two considerable oil-forming periods in New Zealand. The younger occurred in early Pliocene and late Miocene times and the older in the early Tertiary and late Cretaceous. To the former belong the oil-yielding rocks of New Plymouth and Kotuku, and to the latter those of the East Cape—Gisborne district, Hawke's Bay, and East Wellington, Marlborough and North Canterbury, and Moeraki. The middle Tertiary limestones also contain a trace of oil at many points, though no seepages can be attributed to them. There is some evidence that the thick mudstones of slightly younger age are in places petroliferous. These dark argillaceous beds in the Gisborne and Hawke's Bay regions smell of oil at many points and they may well be the source of the oil in the Murchison basin, So. Island. Here black carbonaceous shales of early Tertiary age also occur. In the petroliferous districts there are numerous examples of the kinds of structure that in other parts of the world contain oil-pools.

In view of the favorable geological indications, the extent of past drilling and the large capital involved, the quantity of crude produced may be considered small. It apparently has been partly due to inexperience and uneconomical methods and partly to the fact that some of the earlier companies seem to have been more interested in promoting sales of stock rather than seriously in producing oil. The entry of the big international companies into the field will mean that the greatest effort will be made in the shortest possible time with a minimum practical expenditure per foot of hole drilled. If oil is there in large quantities, New Zealand will soon take its place in the world as an important producer.

One of the wells at Kotuku, South Island, N.Z.

PAPUAN GEOLOGY
Suggests Good Potentialities

Top — Southwest dipping beds with mudstone valley to east, south of Oiapu camp. Bottom — Oiapu anticline from the south; east and west dipping beds with intervening valley on anticlinal crest. The topography consists of a ring of hills enclosing a low-lying central area, giving rise to an almost perfect canoe valley.

PRELIMINARY drilling for geological information was recently undertaken with definite results by The Papuan Apinaipi Petroleum Company Ltd., of Sydney, Australia, on the Jokea-Apinaipi dome in its area about 80 mi. from Port Moresby, Papua, British New Guinea.

The structure of the company's area consists of a series of elongated domes, *en echelon*. Four units are recognised and mapped—Oiapu anticline, Jokea-Apinaipi dome, Apinaipi anticline, and Lesi anticline. Scout drilling operations have been transferred from the Apinaipi-Jokea dome to the Oiapu structure, which is the largest and least complex and offers the best facilities for securing the maximum amount of geological and palaeontological information with a minimum expenditure.

Hopes of striking commercial oil are most favorable with the Oiapu anticline which consists of an elongated dome having a closure of about 600 ft. The average width of the closed structure is over a mile, while its long axis persists without break for at least seven-and-a-half miles. Its area is over 5,000 acres.

The middle calcareous group, which immediately overlies the mudstone group, was laid down under definitely shallower marine conditions than the corresponding beds at Apinaipi. There seems to be a general tendency, from late Miocene times at least, towards shallow water conditions in the Oiapu area, with deeper conditions northwards. This will receive further study.

Another interesting feature is the possibility of barred basin conditions within the Oiapu structure, although it is not definite. Some 98 ft. stratigraphical thickness of beds should be pierced for each 100 ft. of drilling at the site.

The Apinaipi dome is a much smaller structure than the Oiapu anticline, and the central valley is so small that most wells would have to be on the hill slopes, which would necessitate deeper holes than if a flat valley bottom were available.

No. 1 well at Apinaipi reached a depth of 509 ft. Shows of gas and oil were encountered throughout.

No. 2 well was located adjacent to a gas-blow, and the drill penetrated intensely broken strata. Gas showing a pressure of 250 lb. was encountered at 488 ft. and shows of live oil were creditably reported at 444 ft. and 473 ft. The well attained a depth of 563 ft.

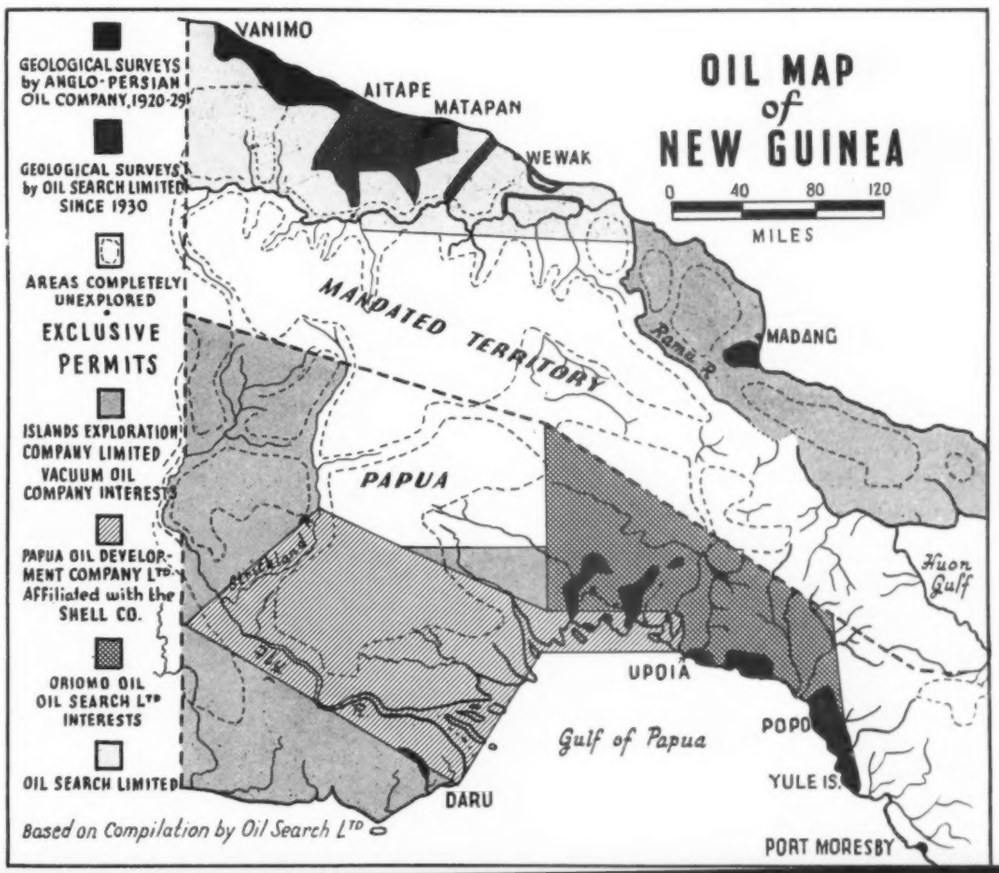
Data obtained from these wells confirmed the geological reports although the Miocene remains untested.

The gas with occasional traces of an extremely light oil suggest that the series is petroliferous at depth.

There is evidence of faulting at Apinaipi, but no faults have as yet been mapped, and as yet there is insufficient evidence available to determine the area of the closed structure, but it is considerably below that of the Oiapu structure. Should oil be struck at Oiapu testing will become imperative.

There are indications of other favorable structures as yet unstudied within the permit area which will justify testing in the event of successful results at Oiapu.

With the object of expediting the geological work and of obtaining data which would be costly or impossible by ground survey, a complete series of aerial photographs of Papuan Apinaipi's permit area is being made by Adastra Airways Pty. Ltd. Scout drilling proceeds on the Oiapu structure with the object of obtaining data of economic and technical importance in preparation for a deep test.



BRITISH GASOLINE Market Policy Questioned

By Alec H. Day

While Practically Free of State Restrictions, Only the Barest Margin Is Maintained Between Import and Retail Prices. Second Largest Market in World Could Prove Far More Remunerative.

IN THE OPINION of many well-informed oil men in London, the fluctuations in British prices for motor spirit during the past twelve months provide ground for serious doubt as to the wisdom of the current policy of distributors. Great Britain is one of the few countries of the world where the sale of petroleum products is left in the hands of importers and distributors without serious Government interference. Taxation is heavy; but otherwise marketing arrangements and price levels are left to the trade, which is also immune from intense internal competition. Yet, the market remains a relatively unremunerative outlet owing to the price policy of the larger distributing companies.

Comparison of prices shows that in times of high and low costs alike, the margin between import and selling values is maintained at a bare minimum. That the margin is kept at the lowest possible level is shown by the following figures of Gulf prices, Gulf-U.K. tanker freights, and retail selling prices for first grade gasoline in Britain.

	Gulf prices 59 Octane spirit		Clean tanker freights	U. K. Motor spirit prices	
	cents.	d.	per ton.	With tax	Net
July, 1937...	6.125	3.45	28s.	1s. 7½d.	11½d.
Aug., 1938..	4.75	2.72	12s.	1s. 7d.	10d.

Gulf price of 59 octane spirit, although not comparable with the first-grade spirit marketed in Britain, supplies a gauge of price levels on which a comparison of import prices may be reasonably based. A fall of 1.375 cents occurred during the past year in Gulf prices, and the sterling equivalent was 0.73 pence per imperial gallon, or approximately ¾d. The fall in freights amounts to about another ⅝d. Total decline in import prices, assuming insurance, handling and evaporation charges the same, thus amounts to 1⅜d. per gallon.

Meanwhile, retail selling prices at service stations have been brought down from 1s. 7½d. to 1s. 7d. per gallon, and since the price now includes 9d. duty against 8d., the net price received by distributors has fallen 1½d. per gallon since July last year. On this showing, the distributing companies are ⅛d. worse off now than they were a year ago. Prices even a year ago were said to be yielding only a small margin over import prices plus distributing charges and other overheads. The market is stated at present to be yielding no margin at all.

National company policy, in fact, seems to have been designed for a long period to anticipate declines in import values by cutting selling prices before reductions are really justified by reduced costs of bringing gasoline to Britain.

The last reduction in price provides an example of this policy. During the January-April period of 1938 the average cost of imports of petroleum products was increasing against 1937. Total value of motor spirit imports was 8.4 percent higher on the four months, although volume rose by only 7.5 percent—yet the selling price of spirit was cut ½d. per gallon on May 13th. It was only when the May import figures were published that signs of a downward turn in the average cost of motor spirit were evident. The national companies were obviously in a hurry to reduce selling prices at the first suggestion of a downward movement in the import price level.

For the big groups operating in the British market, import prices are of course nothing more than cyphers. The motor spirit which they bring in for the most part is produced in the fields of the group and carried in its own and chartered tankers. In these circumstances, changes in import prices mean nothing more than an adjustment of book entries between one constituent and another, and do not affect the earnings of the group as a whole. But selling prices in Britain must affect the total of these profits, however, they are split up among subsidiaries, and are therefore a distinct interest to the controlling companies. A remunerative market is thus to their advantage, and this is just what they have so far refused to create.

No question arises of government control in Britain. Although, as the principal holder of Anglo-Iranian capital, and with consequential interest in Shell-Mex and B.P. Limited, (marketing unit for Shell and Anglo-Iranian) the British Government is doubtless kept informed of proposed price changes, all the evidence shows that it leaves the actual determination of prices to the National distributors.

In view of the proclivity of the latter for keeping profit margins cut to the bone, acquiescence in price policy by the British authorities is easy to understand. Not only does a cut price provide the British public with motor fuel at an unduly low price, but it leaves ample scope for a high level of taxation.

This aspect of the Government's attitude to gasoline prices was illustrated this year. The companies reduced prices by ½d. per gallon in July, 1937, and again by the same amount in February, 1938, so leaving the door wide open for government action. The prompt reply of the Chancellor of the Exchequer was to put on another 1d. to the motor spirit duty in the April Budget, raising the same to 9d. As a result, the motorist after the Budget announcement has been paying 1s. 7½d. per gallon for first-grade spirit, equal to the highest price touched in 1937, while the Exchequer is getting 1d. per gallon more in tax, and the companies 1d. less for their products.

Ever since 1931 the trend of British taxation has been the same. Distributors have tended to cut prices, and the Government has tended equally to impose increase tax burdens. Consequently, the British market has been much less remunerative than it could have been made by a bolder initial directing policy.

Every opportunity is available to the oil industry to make this market—the largest outside the United States—the most remunerative without giving the motorist and commercial vehicle owner anything but a perfectly fair deal. A policy which blocks this objective—it has been stated—can hardly be fundamentaly sound.

While the British market was a continually expanding outlet, infinitesimal profit margins may have been justified, but signs are now appearing that a temporary lull has occurred in the expansion of sales. Oil circles assume, with good reason, that the Government has at present no storage available on its own account, and that imports of gasoline actually increased during the first half of this year over the same period of 1937, instead of the published drop of 28,000 bbl., and that established storage undertakings took care of the same at the Government's behest. It will be remembered that the Admiralty added

six 12,250 ton d.w.c. tankers to its fleet during 1937. Its tanker fleet has an aggregate capacity of 378,212 tons in 67 vessels.

Import figures suggest that commercial demand for motor spirit has already ceased to expand, due perhaps to the growing use of the Diesel engine for busses and trucks. Any relapse in the demand for motor spirit for ordinary uses may be offset by exceptional Government requirements for military purposes such as exercise of the increased air force and tank corps. The general market cannot be expected to expand indefinitely while general trade is declining, or at least until the government's delayed road program makes substantial headway. This consideration seems to strengthen the call for a better margin of selling prices.

That such a market policy has not been adopted already is attributed to several factors. Independent distributors, operating in the easiest—and most thickly populated parts of the country—from the distributors viewpoint, were said to have been securing too large a share of the total sales. Doubts existed as to the ultimate reactions in Britain of the Irish National Refinerys' project, which is designed to produce more than the Irish market itself can absorb. New fears were introduced by the Mexican expropriation, and the possibility of cheap Mexican oil coming to Britain in large quantities.

It is doubted by oil men not in harmony with this marketing policy whether any of these factors is a valid reason for keeping prices bordering on an unremunerative level. Similar reasons have been given over a long series of years for maintenance of this policy, and none of the fears formerly expressed has actually been realised.

Whether the maintenance of a narrow margin has contributed to preventing these apprehensions from being fulfilled is questionable. One possible factor in the policy of the National companies is that they are able to show good profits somewhere in their groups even at the cut prices which have been maintained by motor spirit in Britain during the past years. Their organisations may be so efficient that what appears a bare margin, or no profit at all, is in reality a reasonable remuneration. Conceivably, also, profits on products other than motor spirit provide them with sufficient margin to make overall distribution in Britain worth while, although the published selling prices for petroleum products generally do not support this assumption.

Whatever their position in regard to profits, the big distributors may be safely assumed not averse to making a reasonable profit on motor spirit. The services they render to the British consumer in the highly organized supply of excellent motor fuel entitles them to make a fair turn. This also applies to many of the independents, especially the Federation members, who are an integral part of the market employing considerable British labor and giving good service to customers.

A large proportion of the distribution of the independents consists of supplying commercial consumers, but the price at which this class of business is done is also directly affected by the retail prices fixed by the big distributing concerns. The price lowering policy of the latter thus reacts directly on the profits of the smaller distributors.

Prior to 1936, when the Independent Petroleum Federation first took tangible shape, there was some reason for keeping motor spirit profit margins at a low level. Independents in those days were engaged in fierce competition between themselves, and some doubtedless snatched business wherever they could, often cutting prices to shreds in the processes.

Since the advent of the Federation, the position has changed completely. Independent competition is now on a friendly basis. All the Federation members conduct their business on entirely ethical lines, and have followed all changes in the published prices of National Group. Through their Federation, the small distributors have become a responsible body, deserving recognition by the big companies, and embracing in their alliance all the good elements in the trade apart from the National Distribution companies, Trinidad Leaseholds, Texas and other really large independent concerns.

Although willing enough to cooperate with the major groups, the Independent Petroleum Federation has so far received scant recognition from these undertakings. This is a policy on the part of the latter which seems on the face of it to be short-sighted, for the Federation may well prove extremely valuable as a market factor at some time in the future.

It has in its power to place impediments in the way of any new undesirable entrant into the British market and at the present time might be of great assistance by providing a guarantee that none of its members would handle Mexican oil.

Formation of the Federation, and its success in uniting its constituents has already improved basic conditions behind the motor spirit price structure in Britain and has at the same time provided a foundation on which a more remunerative price level could be built. It remains for the major companies in the market to do the building and bring the independents into cooperation.

GULF EXPORT PRICES FOR MAJOR OIL PRODUCTS

Products		Aug. 10	Aug. 17	Aug. 24
		Cents Per Gallon		
GASOLINE:	U.S. Motor	4¾	4¾	4⅝
	64/66-375 E.P.	4⅞	4⅞	4⅝
	59 Octane and below	4⅝	4⅝	4⅝
	65 Octane and above	5⅛	5⅛	5
AVIATION GASOLINE:	Gulf Export in cargo lots	9½	8¼	8¼
KEROSENE:	44 w.w.	4¼	4¼	4¼
	41/43 w.w.	4	4	4
	41/43 p.w.	4	4	4
GAS OIL:	43 Diesel Index and below	3½	3½	3½
	43/47 Diesel Index	3½	3½	3½
	48/52 Diesel Index	3½	3½	3½
	53/57 Diesel Index	3⅝	3⅝	3⅝
		Dollars Per Barrel		
FUEL OIL:	Bunker C	75	75	75
	Cargo lots	62½	62½	60
	Diesel oil	1.55	1.55	1.55
		Cents Per Gallon		
LUBRICATING OIL:	Bright Stock No. 8	20½	20½	20½
	Bright Stock No. 6½	21½	21½	21½
	600 Warren E.	20½	20½	20½
	600 Unifiltered s.r.	15½	15½	15½
(New York Export Market)	650 Unfiltered s.r.	17½	17½	17½
	600 Flash s.r.	18	18	17½
	630 Flash s.r.	20½	20½	18
	Neutral 200 No. 3	20½	21½	21½
	Neutral 150 No. 3½	19½	20	20
(South Texas Export Market)	Red oil 500 No. 5-6	7¾	7¾	7¾
	750	8¼	8¼	8¼
	1200	8¾	8¾	8¾
	Pale oil 500	7¾	7¾	7¾
	750	8¼	8¼	8¼
	1200	8¾	8¾	8¾
		Dollars Per Barrel		
CRUDE OIL:	East Texas delivered at Gulf for export	1.44	1.44	1.40

FREIGHT RATES

	July 27		Aug. 3		Aug. 10		Aug. 17		Aug. 24	
	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean
Gulf-No. Atl.	15	14	15	14	16	15	16	15	16	15
Gulf-UK. Cont.	11/-	12/-	11/9	12/-	11/6	12/-	11/6	12/-	12/-	12/6

BRAZIL Establishes National Petroleum Council

Presidential Decree Authorizes Official Board to Regulate and Control All Branches of Industry —Effect on Operating Companies Still to Be Determined—Standard Oil's Refinery Not Operating.

As previously reported by World Petroleum a decree law issued in April last provided for nationalization of the Brazilian petroleum trade under direction of a National Petroleum Council. On July 7th President Getulio Vargas published a further decree defining the duties and membership of the Council.

According to the terms of this order the Council will consist of a president and eight counsellors and will be directly under the President of the Republic. Its membership will include representatives of the Ministries of War, Marine, Finance, Agriculture, Communications and Public Works, Labor and representatives nominated by the Industrial Federation of Brazil and the Federation of the Brazilian Chambers of Commerce. Its president must be a native Brazilian who shall have had no connection with the petroleum industry or business within five years previous to his appointment. The members of the council will serve for a term of three years and may be reappointed. A vice-president will be chosen from among the counsellors. The executive committee will consist of the president, the vice-president and one counsellor who will be named by the president of the republic. Meetings of the council will be held every week or oftener whenever necessary. Decisions will be by majority vote, but the Ministries of War and of Marine will have the right to object to any measure which may seem to conflict with the national defense. The names of the members have not yet been announced.

The functions of the council will include the following:

To authorize, to regulate and to control the importation, exportation, transportation (including the construction of pipelines) and the distribution and trade of petroleum and its derivatives within the national territory.

To authorize the construction of whatever refineries or storage installations may seem to be necessary.

To establish prices of refined products, imported or fabricated within the country, and to make these prices as uniform as possible throughout the country.

To advise concerning the issuance of concessions or the exploitation of deposits of petroleum, natural gas, bituminous rocks, etc. To advise concerning the establishment of preserves and reserve zones and areas supposed to contain petroleum.

To authorize and supervise the financial operations of enterprises which may be constituted for the purpose of carrying on the petroleum refining industry whether imported or product of the country. To supervise the mercantile operations of the said enterprises, and to examine their books whenever necessary to determine the exact cost of production.

To establish uniform methods of accounting.

To maintain a statistical service.

To advise the government as to measures for promoting the search for petroleum in the country and for lowering the cost of liquid hydro-carbon in general, whether national or imported products.

To propose measures that will stimulate the oil shale distilling industry. To determine which, among the distillation products of petroleum, are to be included in the national supply.

To verify periodically the consumption of liquid hydrocarbons in the different parts of the country, the existing stocks, and to allot quotas of importation within certain limits of time and to allot the distribution of these quotas among different ports of entry.

To establish minimum stocks of fluid hydrocarbon to be maintained by the importers or refiners at designated points within the country.

To advise concerning changes in taxes of whatever nature which are to be borne by the petroleum industry and the petroleum trade and to suggest new taxes.

It is provided that no existing taxes of whatever nature on petroleum and its by-products shall be changed and no new fiscal burdens created, without a previous hearing before the national petroleum council. No international agreement affecting the trade or industry in petroleum will be assumed by the government without previous consultation with the National Petroleum Council.

A technical department is created for official research on petroleum deposits and when such are discovered, a commission will decide as to their exploitation and industrialization. Pre-existing government agencies having to do with petroleum are placed under the jurisdiction of the national petroleum council.

The council is authorized to take such measures as may be necessary for executing the laws and regulations relating to the petroleum business, and may seize goods and establishments of whatever nature that may have any connection with violations of these laws.

For meeting the expenses of the council there is established a tax of three milreis per ton of crude petroleum, gasoline, kerosene, fuel oil, lubricating oil and whatever other products the council decides to tax, whether these products are imported or products in the country from natural or foreign raw materials.

Crude petroleum, whether of native production or imported, when used as raw material by national refineries shall be exempt from the above tax. This law takes effect from the date of its publication.

Until the council begins to function, members of the petroleum trade will not know the exact terms under which their business can be carried on, but, as indicated above, the authority of the new organization is sweeping. It is not expected that immediate drastic changes will be introduced, as Brazil must continue to depend upon imports unless or until indigenous supplies can be developed. One of the purposes of the decree law of April last was to lead to the establishment of a refining industry under native control and it was provided that all refineries must be under Brazilian ownership. As a consequence work on the new refinery being built by Standard Oil Company of Brazil at Sao Paulo was suspended. The fate of this plant is still undetermined but when the petroleum council is fully organized some arrangement for its completion and operation probably will be made.

Drilling in the Szentadorjan Lispe, Southern Hungary, is being carried on by the M.A.O.R.T. (Magyar Amerikai Olajipari R.T.) subsidiary of the Austro-Gasco, controlled by the Jersey Standard, and formerly known as the European Gas & Electric Company. Three wells have been completed, two of which are commercial producers, and average about 375 bbl. per day.

ANGLO-AMERICAN'S Producer in Scotland

FOR TWO years persistent efforts to find oil in Great Britain have been made by several companies and at the present time ten wells are being drilled, including seven by D'Arcy Exploration Company Ltd. Anglo-American Oil Company Ltd., who recently drilled below 4,000 ft. in the south of England to be rewarded with a dry hole, have been successful in bringing in a producer near Dalkeith (Midlothian). The well came in with 8-10 bbl. per day at 1,733-1,760 ft. Drilling had been carried down to 3,857 ft., when it was decided to test the shallower sands. Work is under the direction of A. H. Chapman, an American.

Even in its early stages, the Dalkeith well presented some tough technical problems. Between 50 to 160 feet, the rotary drill struck a layer composed of extremely porous sandstone which, absorbing the mud fluid, caused a loss of circulation and dangerous possibilities of the drill pipe sticking in the hole.

The crew were encouraged by traces of oil and gas encountered at various depths but on the chance of finding something more substantial at lower levels, drilling was continued. Drill stem tests of the lower sands showed a considerable quantity of natural gas; these gas sands were plugged off and production tests were made of the upper sands. About three-and-a-half barrels were obtained on the first six-hour test. It was found to be of excellent quality, 0.830 deg. specific gravity (39 deg. A.P.I.) and contained 12 percent of gasoline and 12 percent of kerosene. Later tests showed the well to be capable of producing 8-10 bbl. of crude oil per day. Schlumberger logging showed three likely sands.

After two weeks of production tests, it was decided to shoot the well in an effort to increase the flow of oil from the porous sandstone. This treatment consisted of exploding a charge of 500 lb. of gelatinous nitroglycerine in the well at the level of the oil bearing sands to open up cracks and crevices in the strata.

For 16 hours daily for three days the well was swabbed, producing an average of eight barrels per day for the period. The liner, which appeared to have been damaged by the explosion is being pulled out, and it is intended to test the sands at 2,050 to 2,150 ft.

Should this and neighboring wells prove to be substantial producers, the discovery will be of great value to the British navy in time of war, as it will be a simple matter to run a short pipeline to the naval base at Rosyth in the Firth of the Forth.

Fastest drilling in Great Britain is being made by the Gulf Exploration Company, who when last reported were down to almost 4,300 ft. at Penhurst No. 1 in Kent. For many weeks Steel Bros. & Company have suspended operations at Upper Booth, owing to water having been encountered in the limestone. It is not known when operations will be resumed. Hardstoft No. 1, which since 1919 has produced over 21,000 bbl. of high quality crude, is being cleaned out by D'Arcy Exploration Company and will be deepened. Considerable difficulty was encountered in pulling the old casing.

D'Arcy's No. 1 Cousland well near Dalkeith, Scotland, was started in September, 1937, and was down to 2,396 ft. early in August last after having passed through a number of oil and gas bearing sands, which are awaiting further tests.

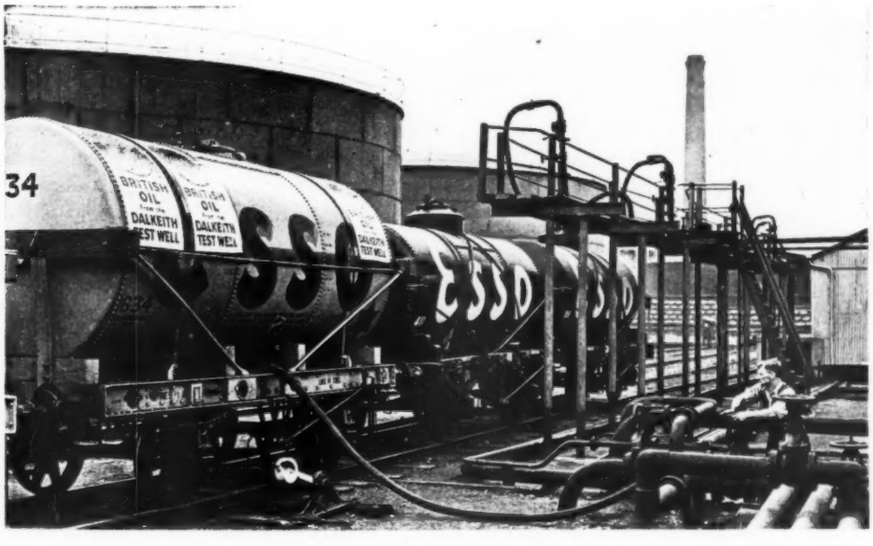
Not a gusher—just the discharge of oil which followed the shooting of the first producer in Britain's new drilling campaign.

BRITISH Petroleum Imports (Revised Figures)

THROUGH an oversight, the various figures of British petroleum imports and customs' releases published in the August WORLD PETROLEUM were converted by our contributor from Imperial gallons at the rate of 38 per U.S. barrel instead of 35, resulting in all the figures being too low. Corrected conversions are as follows:—

Period	Purpose	Quantity
Jan.-May 1938	Customs releases (Total	24,764,000 bbl.
Jan.-June 1938	Customs Releases (Gasoline)	18,560,000 bbl.
Jan.-June 1937	Customs Releases (Gasoline)	18,227,000 bbl.
Jan.-June 1938	Gasoline imports	20,360,000 bbl.
Jan.-June 1937	Gasoline imports	20,407,000 bbl.
Jan.-June 1938	Total imports	47,966,000 bbl.
Jan.-June 1937	Total imports	43,902,000 bbl.
Jan.-June 1938	Total exports	1,997,000 bbl.
Jan.-June 1938	Fuel oil imports	11,395,000 bbl.
Jan.-June 1937	Fuel oil imports	9,670,000 bbl.
Jan.-June 1938	Crude oil imports	8,608,000 bbl.
Jan.-June 1937	Crude oil imports	6,932,000 bbl.
Jan.-June 1938	Total bunkers shipped	704,000 bbl.

Values in dollars were given at the rate of £1 = $5.



Discharging the first consignment of oil from the tank car at Purfleet, where it is to be tested for quality and to ascertain its possible use.

ECONOMICS AND GEOLOGY of the Rocky Mountain Area II

By Prof. L. C. Uren

Second Installment of Prof. Uren's Exhaustive Study of the Oil and Gas Fields of the Rocky Mountain Area Made for World Petroleum.

Other Powder River Fields. Two of the most important fields of Wyoming, the Salt Creek and Lance Creek Fields described above, occur in the Powder River Basin, which includes all of northeastern Wyoming and a portion of southeastern Montana. The Soap Creek Field of southeastern Montana, previously mentioned, is also properly included in this province. Other Wyoming fields of lesser importance within the Powder River Basin, that have contributed substantial amounts of oil, include the Big Muddy Field of Converse County, the Osage Field of Weston County and the Mule Creek Field of Niobrara County. Conditions in the Big Muddy Field are much like those at Salt Creek. These are all light oil fields and their combined gross production to Jan. 1, 1937, has been 29,635,000 bbl. Of this, the Big Muddy Field accounted for 24,771,000 bbl. Their combined reserves were estimated at 12,433,000 bbl. in 1935 and of this, 9,609,000 bbl. was in the Big Muddy Field. The Billy Creek Field of Johnson County, also in the Powder River Basin, produces only gas, which is transmitted by pipeline to the towns of Buffalo and Sheridan.

Oregon Basin Field, one of the important fields on the west side of the Big Horn Basin, in Park County, Wyoming, was first developed in 1912 as a gas field, producing from the Cloverly Formation (Lower Cretaceous), but only a few wells were drilled in a proven area of but 1,300 acres. Up to January 1, 1937, this area has produced gas estimated in volume at 1,494,000,000 cu. ft. Only two of these gas wells are now producing and their yield is small. In 1927, deeper drilling disclosed that the Embar Formation (Permian) and Tensleep Sandstone (Pennsylvanian) are oil bearing, and 35 wells drilled to these horizons since that time, have resulted in production of 7,181,041 bbl. of oil and the establishment of a further reserve estimated by Boyer in 1935 at 79,790,000 bbl. the largest reserve in any one field in the State of Wyoming. The productive area of the oil-bearing formation is estimated at 10,000 acres. The Madison Limestone may also be productive, but this horizon has not been thoroughly tested. Current production of oil from this field is small because of the limited demand for the low-gravity oil that it produces. The 1936 production was but 915,041 bbl.

The Oregon Basin Field occurs on two local domes superimposed on the axis of a well defined anticline with some 900 ft. of closure. The Cloverly Formation, producing gas only, was encountered at depths of from 1,500 to 1,550 ft. and the Embar-Tensleep oil-producing horizon is found in an interval which ranges from 3,500 to 3,900 ft. in depth. The oil produced, as in most other fields of the Big Horn Basin, is black oil of 20 to 21 deg. A.P.I. gravity and contains upwards of three percent of sulphur. It yields only 14 percent of gasoline and naphtha by straight distillation and six to seven percent of kerosene distillate. Both gas and oil are transmitted from the field to the town of Cody, 13 miles disdant, where a refinery of 1,500 bbl. daily crude capacity is situated. While development of this field has been slow because of the limited demand for its product, utilization of the Wyoming black oils is growing as the supply of light oil wanes, and the large reserve of available oil promises an active future for this area.

Grass Creek Field. Situated in the southwestern part of the Big Horn Basin, in Hot Springs County, Wyoming, this field is second only to Salt Creek among the fields of Wyoming in the gross volume of oil produced. Discovered in 1914, the field had produced on January 1, 1937, a total of 25,351,600 bbl. of oil and reserves still to be produced in future were estimated in 1935 at upwards of 44,000,000 bbl. Of the reserve, 38,000,000 bbl. is black oil. The 1936 production from 330 wells in this field was 553,602 bbl.

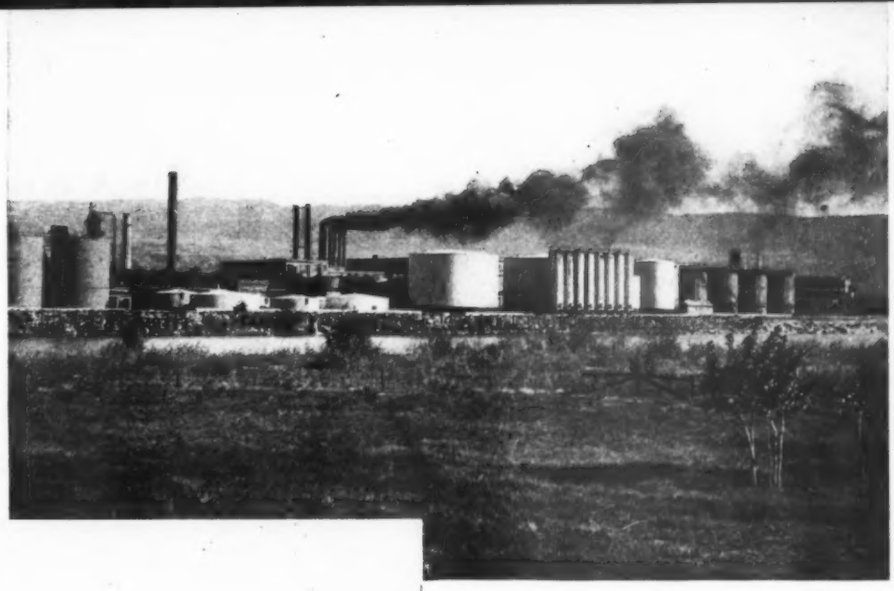
The field produces from several horizons, some of which produce light, high gravity oil and two of which produce heavy, asphaltic black oil. First production was 44 gravity oil from the Frontier Sands (Upper Cretaceous), encountered at depths ranging from 800 to 1,200 ft., and the first eight years of development in the field was confined to this horizon. Minor occurrences of gas have also been noted in the Muddy and Dakota Sands. In 1922, black, asphaltic oil of 22 gravity was found in the Embar and Tensleep horizons (Permian and Pennsylvanian respectively). Wells producing from these formations must be drilled to depths of from 3,600 to 4,000 ft. Indications of commercial production of black oil have also been found in the Morrison Formation (Lower Cretaceous), not generally productive in the Wyoming fields, and production may be found in the underlying Madison Limestone which is as yet untested. Accumulation has been determined by the presence of a dome of irregular form.

The Grass Creek Field is served by a gas pipeline which connects several of the Big Horn Basin fields, and by an oil line connecting with rail shipping facilities near Chatham, Washakie County, on the Burlington R.R. The nearest refineries are at Thermopolis, a 1,500 bbl. daily capacity plant, and at Worland, a 200 bbl. plant. Natural gas available in the field has been used in repressuring partially depleted sands.

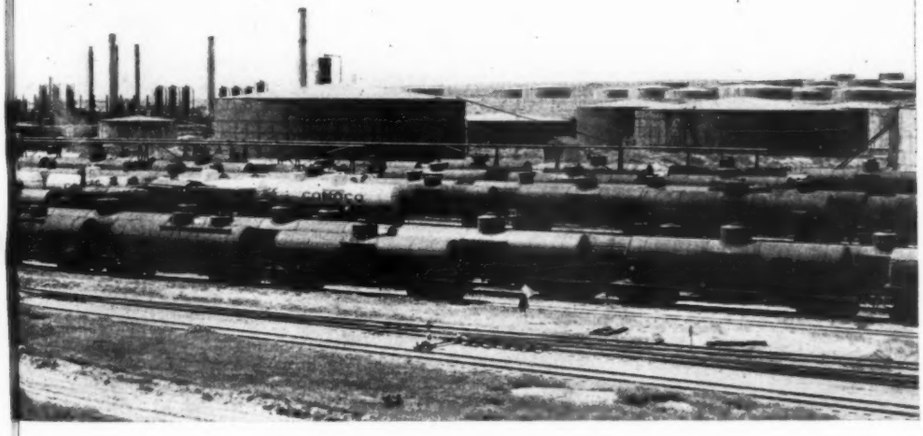
Other Big Horn Fields. The Big Horn Basin of north-western Wyoming, is a well defined structural province that includes a considerable number of oil and gas pools presenting more or less similar conditions. In addition to the Oregon Basin and Grass Creek fields described above, the Elk Basin, Frannie, Byron, Garland and Hamilton fields have recently and are currently producing substantial volumes of oil; and the Hidden Dome, Little Buffalo Basin, Byron, Elk Basin and Garland fields are commercial gas producers. In addition to the fields named, there are a number of other structures in the Big Horn Basin on which discoveries have been made, but which have not as yet been developed to the point where they assume importance in present-day production. Among these, the Black Mountain, Four Bear, North and South Sunshine, Pitchfork, Spring Creek, Warm Springs and Waugh Dome have proven reserves of apparently substantial character. The Dry Creek Field in southern

Montana, previously described, should also be included among the producing structures of the Big Horn Basin.

A sketch map of the Big Horn Basin, showing the geographic relationship existing between the many structures that



The railroad plays an important role in distribution of Rocky Mountain oil industry products. Shipping, storage and refining facilities at Casper, Wyoming, Standard Oil Co. of Ind. refinery the largest in the territory.



have been formed about its rim will be given in the next instalment. These fields are where most of Wyoming's black oil is found, estimated aggregate black oil reserves of the Big Horn Basin fields being upwards of 218,000,000 bbl. and the likelihood of this figure being considerably increased when further drilling is done. Due to lack of demand for the black oils, many of these fields have not been developed beyond the discovery stage, further development awaiting expansion of markets. Fields producing light oil in the Big Horn Basin, in addition to Grass Creek which is described above, include Elk Basin, Badger Basin and Greybull. The Badger Basin Field is noteworthy as the deepest producing field in the Rocky Mountain region up to the present time. Two producing wells have been drilled to the Frontier sands, one with cable tools and the other with rotary tools, to depths of 8,500 ft.

Some of the Big Horn Basin fields produce gas only; some produce oil with very little gas, and others produce both oil and gas in commercial amounts. Where both oil and gas are produced, it is noteworthy that the gas is always found in separate formations from those which yield the oil: that is, any particular horizon in any one field yields either oil or gas, seldom or never both. Some of the fields have been produced for a sufficient time to suffer a considerable depletion. In a few such cases, efforts have been made to stimulate production by reinjection of gas into the oil-yielding reservoir rocks. This has been done with considerable success in the Elk Basin and Grass Creek fields.

Rock River Field. The Rock River (Rock Creek) field in Carbon County, Wyoming, near the north-western edge of the Laramie Basin, was discovered in 1918 and up to January 1, 1937, had produced 16,590,400 bbl. of oil from 71 wells, only 52 of which were producing at that time. The proven area is 1,300 acres. The 1936 production was 606,440 bbl. Reserves were estimated in 1935 at 10,654,000 bbl.

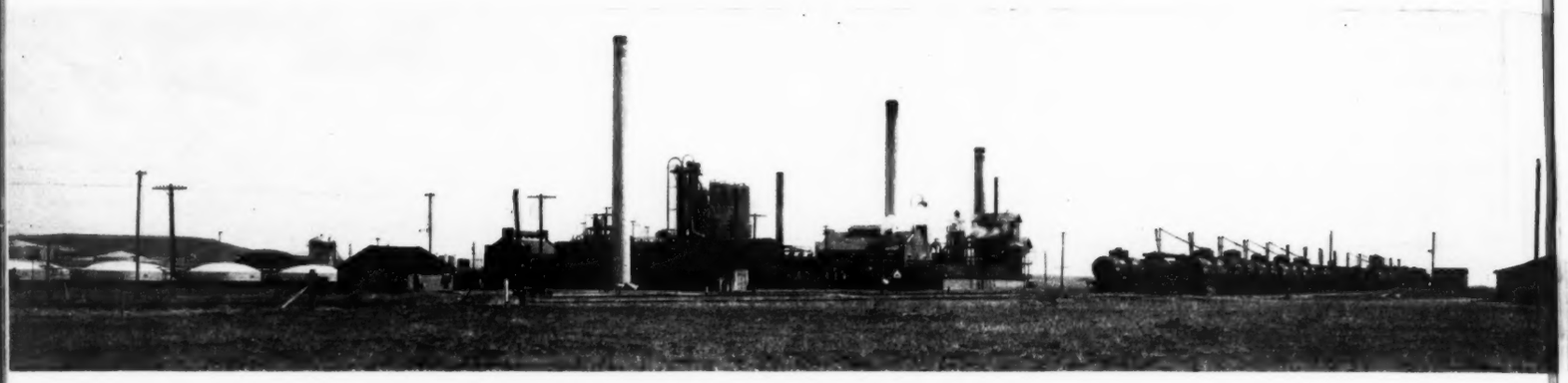
Accumulation has been influenced by a well defined anticlinal structure having 1,600 ft. of closure. Production is from the First and Second Muddy and Dakota Sands of the Dakota group (Upper Cretaceous) and the Sundance (Jurassic), encountered respectively at depths of 2,600-2,800 and 3,150 and 3,250 ft. As in some other fields of Wyoming, there is a marked plunge of the water table surrounding the oil accumulation with respect to structure, production being found as much as 900 ft. lower on one end of the structure than on the other. Gas is associated with the oil and one well producing only gas has been drilled near the crest of the structure. Its initial production was 15,000,000 cu. ft. per day.

The oil produced in the Rock River Field is brownish green in color and has a gravity of 34-37 deg. A. P. I. Sulphur content is less than 0.1 percent, gasoline and naphtha yield by straight distillation averages 30 percent and kerosene distillate, nine percent.

Gas produced in the field was for a time treated in a natural gasoline recovery plant of 5,000 gal. daily capacity, the gas yielding about one gallon per thousand cubic feet. Residue gas from this plant has been utilized in field operations, partly in gas-driving by reinjection into partially depleted sands. Gas is now piped to the field for injection purposes, from the near-by Medicine Bow field. The field is served by two short pipelines, one a crude oil line and the other a gasoline line, connecting with shipping facilities at the town of Rock River, Albany County, Wyoming, on the Union Pacific R.R. Operations in this field are controlled entirely by the Ohio Oil Company. If recent estimates of reserves in this field are dependable, the Rock Creek Field will eventually produce about 27,000,000 bbl. of oil worth at least $32,500,000. Deeper tests may also disclose commercial production in the Pennsylvanian formations.

Medicine Bow Field. This field, in Carbon County, Wyoming, the most recently discovered field of the Laramie Basin group, is of special interest in as much as development is proceeding actively at the present time. It also has the distinction of producing a higher gravity oil than any other field in Wyoming. Up to the end of 1936, only eight wells had been completed in this field, five of which were then producing. Their yield in 1936, the first year of productivity, was 184,920 bbl. of oil and 285,000,000 cu. ft. of gas.

Production in this field is derived from



Socony-Vacuum Oil Company's "White Eagle" refinery, Casper, Wyoming.

two sandstone horizons in the Sundance Formation (Jurassic), encountered at depths ranging from 5,200 to 5,450 ft. Drilling is by the rotary method. Accumulation is controlled by a large anticline with more than 3,500 ft. of closure, but apparently only about 800 acres of the crestal area is occupied by oil. The early wells in this field had very high initial productions, the discovery well flowing 6,300 bbl. of oil and 80,000,000 cu. ft. of wet gas per day. The oil is a semi-transparent, yellowish green oil of paraffin base, having an A. P. I. gravity of 63 deg. By straight-run distillation it yields 78 percent of gasoline and naphtha and 11 percent of kerosene distillate. Sulphur content is less than 0.1 percent. The available reserve cannot be estimated with any certainty at this time, but is possibly of the order of 10,000,000 to 20,000,000 bbl. So volatile is this oil that it has been found necessary to erect a stabilization plant to remove light fractions and reduce vapor pressure of the oil shipped from the field. An oil pipeline has been built to the town of Medicine Bow, a near-by shipping point on the Union Pacific R.R. Medicine Bow oil shares the market previously created for the product of the near-by Rock River Field and capacities of refineries using this oil have recently been expanded to take care of the increased supply. The field is controlled jointly by the Ohio Oil Co. and California Company (Standard Oil Co. of California.)

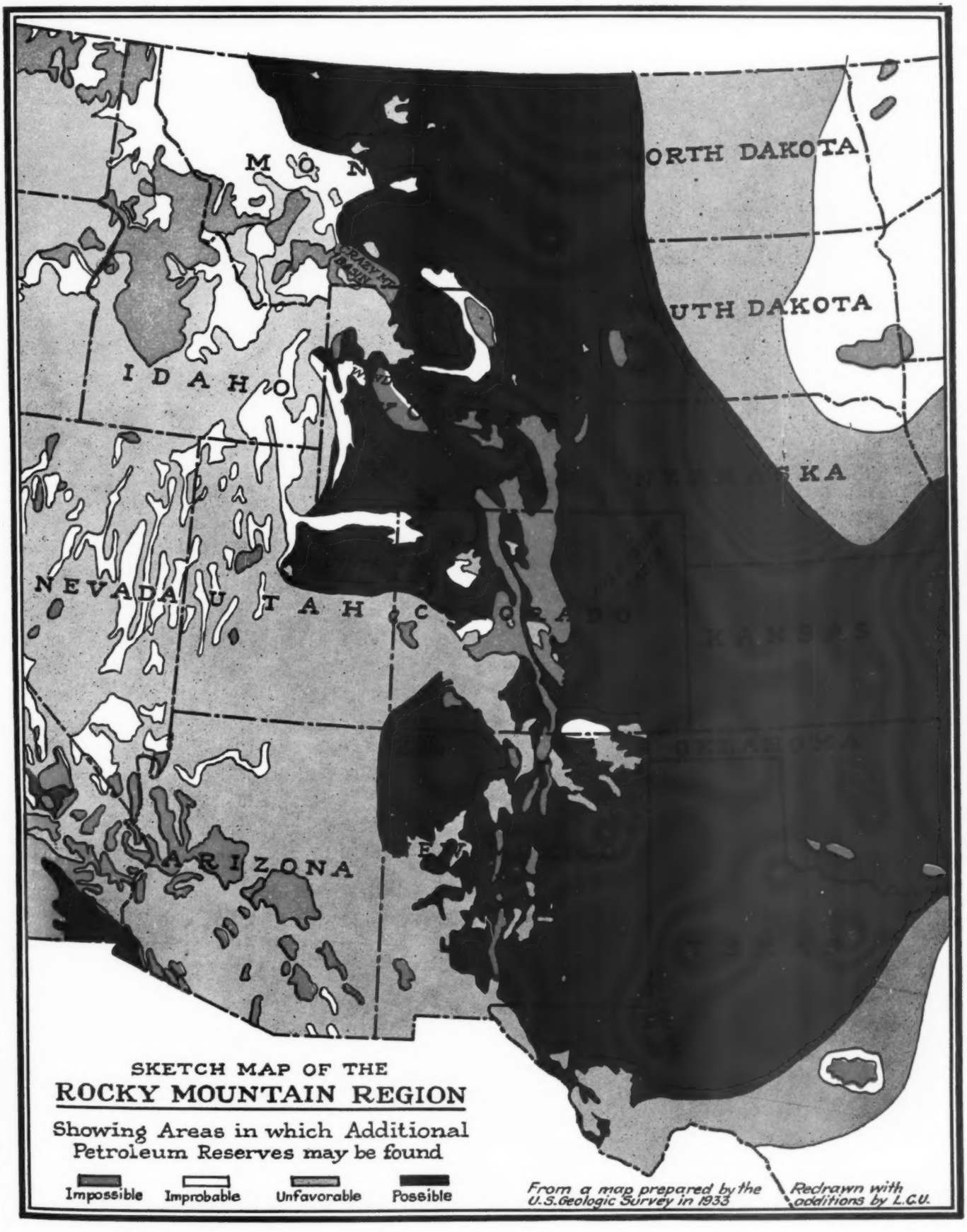
Other Laramie Basin Fields. In southeastern Wyoming—in addition to the Rock River and Medicine Bow fields described above—there are the less important Simpson Ridge, Dutton Creek, Quealy and Rex Lake oil fields and the Allen Lake gas field. The Quealy Field in Albany County, is a comparatively recent discovery (1933) and of current interest as it is now in course of development. The aggregate oil production of these fields up to January 1, 1937, was but 667,000 bbl. and their combined productive area is only 670 acres. Their combined reserves probably do not exceed 5,000,000 bbl. in horizons thus far developed; however, the Sundance horizon, so prolific a producer in the Medicine Bow field, has not yet been tested in these areas. The Allen Lake gas field in Carbon County, also small in area, has during the three years since its discovery, produced 1,504,000,000 cu. ft. of gas from only three wells. Gas is transmitted from the field to the city of Laramie.

Lost Soldier Field. The Lost Soldier Field in Sweetwater County, Wyoming, is situated in the eastern portion of the Green River Basin and was discovered in 1916. Total oil production since that time up to the end of 1936, was 18,437,600 bbl. and the 1936 production was 465,166 bbl. A total of 78 wells have been drilled in this field, of which 60 were producing during 1936. The productive area is about 450 acres. Estimated oil reserves in 1935 amounted to 7,800,000 bbl. The Lost Soldier Field is situated on a well defined, symmetrical dome. The wells produce from four different horizons: the Frontier, the Dakota and Lakota group, the Sundance and the Tensleep. First production was secured from the Frontier formation at shallow depths ranging from 300 to 600 ft., and exploitation was confined to this horizon during the first six years until the Dakota-Lakota sands were shown to be productive in 1922. These sands were encountered at depths ranging from 1,500 to 1,700 ft. Deeper drilling in 1926 proved the Sundance horizon productive at 1,950 to 2,150 ft. and in 1930 still deeper exploration found production in the Tensleep Formation in the interval 3,900 to 4,000 ft.

The oils produced in the Lost Soldier Field are of intermediate type, ranging from 29 to 35 deg. A. P. I. Oils produced from the Sundance and overlying formations are comparatively deficient in light fractions, yielding only 7 to 14 percent of gasoline and naphtha and no kerosene distillate. However, they contain substantial amounts of light lubricating stock. The Tensleep oil is of lighter gravity (35 deg. A. P. I.) and yields up to 29 percent of gasoline and naphtha and 10 percent of kerosene distillate. Sulphur content of the Tensleep oil however, ranges as high as 1.5 percent, while that of the oils from the shallower horizons is less than 0.5 percent.

The Lost Soldier Field is but one of a group of seven situated in the almost isolated east end of the Great Divide Basin, an eastward extension of the Wind River Basin, all but one of which produce from the same formations under more or less similar conditions. Other fields of the group are: the Sheep Creek Field of Fremont County and the Wertz, Mahoney, Ferris, West Ferris and General Petroleum (G. P.) Dome, situated in north-western Carbon County. The Wertz, West Ferris and Mahoney Fields are important gas producers, having yielded upwards of 141,000,000,000 cu. ft. of gas up to January 1, 1937. Unlike other fields of the group, the Sheep Creek Field produces a low gravity (24 deg.) black oil from the Embar Formation of Permian age. Gross oil reserves of these fields (other than the Lost Soldier Field, described above), were estimated in 1935 to be upwards of 2,500,000 bbl., most of which is classed as black oil. Productive acreage is small, aggregating only 4,600 acres, 3,500 of which is in the West Ferris gas field.

Oil is shipped from the fields of the Lost Soldier group by pipeline to Parco on the Union Pacific R.R., where the Sinclair Oil and Refining Company's refinery is situated. This is one of the largest refineries in Wyoming, which has a crude capacity of 8,000 bbl. daily and a cracking capacity of 4,000 bbl. Additions to this plant were being made last summer. Gas is moved from the gas-producing fields of the group to the town of Rawlins and to Parco and Casper for use in refinery operations. Two natural gasoline recovery plants having a combined capacity of 6,200 gal. daily, are operated by the Sinclair Oil and Gas Co. on gas produced from these fields.


ORTH DAKOTA
UTH DAKOTA
KA
M O N
I D A H O
NEVADA
U T A H
C O L O
ARIZONA
SKETCH MAP OF THE
ROCKY MOUNTAIN REGION
Showing Areas in which Additional
Petroleum Reserves may be found
Impossible
Improbable
Unfavorable
Possible
From a map prepared by the U.S. Geologic Survey in 1933
Redrawn with additions by L.C.U.

Denver has a superb setting in the midst of a fertile valley, surrounded by lofty mountain peaks.

La Barge Field. This field in Lincoln and Sublette Counties, in the western portion of the Green River Basin, was discovered in 1923. The field is of interest in that it produces from the Wasatch Formation of Eocene age, not elsewhere productive in this region. Accumulation has apparently been due to an angular unconformity bringing a reservoir rock into contact with sharply folded Cretaceous shales, which have apparently been the source of the oil. The field is also unusual because of the highly variable quality of the oil produced. The oil-yielding zone, ranging from 200 to 300 ft. in thickness, produces 45 gravity oil on the north end of the structure, with 25 to 30 deg. oil on the crest and 19 to 20 deg. oil on the south end. The wells range in depth from 650 to 1,300 ft.

Up to January 1, 1937, the La Barge Field produced 4,729,400 bbl. of oil from 110 wells, only 91 of which were operated in 1936. Their 1936 production was 428,400 bbl. The productive area is about 950 acres. Reserves were estimated in 1935 at

5,378,000 bbl., all classified as light oil. The lighter grades of La Barge oil yield as much as 41 percent of gasoline and naphtha and 11 percent of kerosene distillate, but the heavier oils contain almost none of these fractions, being high in lubricating oil fractions. The sulphur content is less than 0.2 percent.

A small refinery (100 bbl. capacity) is situated at the town of La Barge, near the south end of the field, but most of the oil produced is transported by pipeline to rail shipping facilities at Opal, Lincoln County, on the Oregon Short Line Railway.

Baxter Basin Gas Fields. Baxter Basin Fields are situated in southern Sweetwater County, south-western Wyoming, near the towns of Green River and Rock Springs, and are important producers of natural gas, but yield no oil. Producing from Frontier, Dakota and Sundance sands, 28 wells on an area of about 9,800 acres, have yielded upwards of 21,724,000,000 cu. ft. of natural gas from the time of discovery to January 1, 1937. The wells range in depth from 2,350 to 3,500 ft. The Baxter Basin fields are situated on four domes, three of them small, along the crest of the Rock Springs Anticline.

Gas is transmitted from the Baxter Basin fields to the near-by towns of Rock Springs and Green River, and the Uinta gas pipeline carries the gas from Green River to Salt Lake City, Utah, and intermediate towns.

Other fields of the Green River Basin, south-western Wyoming, include the Dry Piney Field in Sublette County, the Spring Valley and Aspen Fields in Uinta County and the Eight Mile Lake gas field in Carbon County. These fields are relatively unimportant and are now very small producers. Reserves are also negligible. Dry Piney, Aspen and Spring Valley produce only oil and Eight Mile Lake produces only gas. A pipeline from the field carries gas to Parco, Carbon County.

Wind River Basin. The Wind River Basin, which includes a large area in western and central Wyoming, contains, many small and, at present, commercially unimportant oil and gas fields. A few, such as the Dallas, Derby, and Lander (Hudson) fields in Fremont County, and the South Casper Creek Field in Natrona County, deserve special mention as being more productive than others of the group, but their aggregate production up to January 1, 1937, has been only 7,747,000 bbl. and their combined production in 1936 was only 514,000 bbl. Apparent reserves aggregate only about 15,700,000 bbl. Most of the oil produced and in reserve in these fields is of comparatively low A. P. I gravity and is classified as black oil. The South Casper Creek Field is unique in that it produces an oil of only 15 deg. A. P. I. gravity: the heaviest oil produced in the Rocky Mountain region.

Broadmoor Hotel, Colorado Springs—favorite headquarters for A.P.I. summer conventions.

Other oil fields in the Wind River Basin than those mentioned above, are the Poison Spider, Iron Creek, Oil Mountain, Alkali Butte, Sage Creek, Pilot Butte, Maverick Springs, Circle Ridge, Sheldon and Notches Fields. In addition to these, there are a number of fields that have yielded important volumes of natural gas. Among these, the Big Sand Draw, Muskrat and Boone Fields deserve special mention. Their aggregate gas production, prior to Jan. 1, 1937, was 49,777,000,000 cu. ft. and their 1936 production was 4,022,000,000 cu. ft., mostly from Big Sand Draw.

COLORADO FIELDS

A comparatively small producer of oil and gas in comparison with Montana and Wyoming, Colorado nevertheless has a number of producing fields and potential producing areas that must be taken into account in any review of the petroleum industry of the Rocky Mountain region. Thirty oil and gas fields in Colorado were discovered prior to 1937. Of these, only eight have been regarded as sufficiently important to warrant separate listing in U. S. Government oil production statistics, and one is an important gas producer. Gross production of oil in Colorado from the time of initial recorded production in 1887 to the beginning of 1937, was 33,646,-239 bbl. and the gross production of gas has been estimated at 16,414,000,000 cu. ft. Total proven acreage of oil and gas land is 19,210, of which 12,880 acres is classified as oil-producing. A total of 1,509 oil and gas wells have been drilled, only 229 of which were producing oil at the close of the year 1936, while nine were producing gas. Colorado's available oil reserves in present-known fields were estimated in 1935 at 24,754,000 bbl.

As explained in a previous section, the oil and gas fields of Colorado are situated in three structural basins: the Green River Basin of western Wyoming, which extends into north-western Colorado and includes a number of Colorado fields; the Uinta Basin, which includes several fields in western Colorado and eastern Utah, and the Julesburg Basin of north-eastern Colorado. This classification will be adhered to in reviewing the several producing fields.

Iles Field. This field in Moffat County, Colorado, is situated on a dome of about 500 ft. closure, probably formed by faulting of the Axial Basin Anticline. The structure is unique among others of the locality in that it is cut by numerous faults of considerable magnitude. There are three producing formations: a shale zone, 75 to 100 ft. above the Dakota Sandstone (Upper Cretaceous); the Morrison Sand (Lower Cretaceous) and the Sundance Sand Jurassic). These horizons are reached on the top of the structure at depths of 2,500 ft., 3,050 ft. and 3,225 ft. respectively. Wells on top of the structure apparently encountered a primary gas cap in the Morrison Sand, individual wells producing from 3,000,000 to 7,000,000 cu. ft. of gas daily from this

horizon. Structurally lower, on the flanks of the dome, the formations produce both gas and oil. The productive area is about 600 acres.

Discovered in 1924, up to the beginning of 1937, this field had produced 5,346,187 bbl. of oil from 37 wells, 32 of which were producing at the end of 1936. The 1936 production was 1,164,540 bbl. Available reserves were estimated in 1935 at 12,000,000 bbl. The oil ranges in A. P. I. gravity from 31 to 37 deg., yields from 13 to 15 percent of gasoline and naphtha and about 11 percent of kerosene by straight distillation. Sulphur content is less than 0.1 percent. In July, 1937, the quoted price of this oil ranged from $1.12 to $1.18. Pipelines carry the oil to the town of Craig, Colorado, where The Texas Company operates a refinery having a crude capacity of 1,200 bbl. and a cracking capacity of the same amount. Rail connections are also afforded at Craig for shipment of crude or refined products over the Denver and Salt Lake R.R.

Moffat Field. The Moffat or Hamilton Field is situated only a few miles east of the Iles Field, in Moffat County, Colorado. The field occupies a pronounced domal structure having a closure of 500 ft. The Dakota Sand of Upper Cretaceous age is the principal producing horizon, but oil has also been found in the deeper Morrison (Lower Cretaceous) and Sundance (Jurassic) sands. At the crest of the structure, these sands are encountered at depths of 3,800, 4,250 and 4,450 ft. respectively.

Discovered in 1923, only 23 wells were completed in this field prior to January 1, 1937, and of these, only 12 were producing at this time. Their 1936 production was 150,327 bbl. and their gross production up to the end of 1936, was 5,197,680 bbl. The productive area is about 400 acres. Available reserves were estimated in 1935 at 1,000,000 bbl. The oil produced ranges in gravity from 38 to 40 deg. A. P. I. and yields 25 to 30 percent of gasoline and naphtha on straight distillation, with 18 to 20 percent of kerosene distillate. The sulphur content is less than 0.1 percent. Oil is transported from this field by pipeline to the near-by town of Craig, Colorado, where a 1,200 bbl. crude capacity and 1,200 bbl. cracking capacity refinery is operated by The Texas Company. Rail shipments may also be made from Craig via the Denver and Salt Lake R.R. A gas pipeline from the field serves the town of Craig and furnishes fuel for the refinery situated there.

The Vermillion-Hiawatha Gas Field, Moffat County, Colorado, and Sweetwater County, Wyoming, is Colorado's principal gas-producing field. Discovered in 1927, it had produced a total of 13,042,700,000 cu. ft. of gas prior to January 1, 1937. The 1936 production was 2,785,800,000 cu. ft. Thus far, only ten wells have been drilled on a productive area of 3,180 acres. Initial productions of early wells ranged as high as 100,000,000 cu. ft. per day.

The gas accumulation occurs at the crest of a large double-crested dome having a closure of more than 400 ft. The age of the producing formation is not certain, but is thought to be either at the base of the Wasatch Formation (Eocene) or in the underlying Cretaceous beds. The producing sands are lenticular and not readily correlated from well to well. A structural high on the western flank of the main dome, is called "West Hiawatha".

Gas from the Hiawatha Field is transmitted through the Uinta pipeline system of the Western Public Service Corporation. to Salt Lake City, Utah.

Powder Wash. The most recently discovered producing field in Colorado is Powder Wash (late in 1936), which occupies one of a series of small domes on the south side of the Washaki Basin in Moffat County. The first well drilled developed an open-flow production of 34,000,000 cu. ft. per day from Wasatch beds encountered at a depth of 2,152 ft. The second well produced 32 to 40 gravity oil by natural flow at the rate of 47½ bbl. per hour. The oil is of paraffin base, is green in color and has such a high wax content that it congeals at 50 deg. F. By straight distillation it yields 25 percent of gasoline and naphtha and 19.5 percent of kerosene distillate. The sulphur content is less than 0.1 percent. The new field is of interest in that it is the first in Colorado to produce oil from Tertiary formations of Eocene age.

In addition to the Iles, Hamilton, Hiawatha and Powder Wash Fields described above, there are three other fields of minor importance that should be mentioned. These are the Bell Rock, Two Creek and Thornburg Fields. The Two Creek field in Routt County is the most important producer of the three, having yielded upwards of 1,472,000 bbl. of oil since its discovery in 1924 and having an estimated reserve of about 300,000 bbl. Fifteen wells in this field are producing a 36 to 52 gravity oil from shales above the Dakota Sandstone, encountered in the wells at depths of from 2,500 to 3,100 ft.

Rangely. The Rangely field, Rio Blanco County, Colorado, is situated on a large dome having a closure of 1,200 ft. Fifty shallow wells on about 320 acres near the crest, have produced about 432,000 bbl. of oil. Discovered in 1919, the field is now approaching exhaustion, only four wells being operated at the beginning of 1937. Production during 1936 was only 28,774 bbl. The producing formation is the Mancos Shale of Upper Cretaceous age, encountered here at a depth of only 600 ft. Several deep tests have been drilled, but all potential producing horizons were found barren except the Dakota sand which in this structure, yields gas only. Four gas wells have been completed in the Dakota, near the crest of the structure, one of which had an open-flow capacity of 74,000,000 cu. ft. per day. The field is in an isolated section of Colorado, near the Utah border, and is without pipeline connections. The nearest rail-road station is at Watson, Utah, 20 miles distant, on the Uinta R.R., which connects with the Denver, Rio Grande and Western R.R. at Mack, Mesa County, Colorado. A refinery of 200 bbl. daily capacity is situated at the town of Rangely, near the eastern edge of the field.

In addition to the Rangely Field, three other structures in western Colorado, in the Uinta Basin, have been proven productive. These are the White River, Piceance Creek and Garmesa fields. No one of these is of sufficient economic importance at the present time to warrant special discription. The White River Field in Rio Blanco County has been a small gas producer, some shallow gas wells on this structure having been drilled as early as 1890. More recent exploration (1918 to 1924) has disclosed minor showings of oil which have not been commercially exploited. A gas well capable of producing 1,876,000 cu. ft. per day has been drilled on the Piceance structure, also in Rio Blanco County. Gas produced in both the White River and Piceance fields comes from the Wasatch Formation of Eocene age. Gas produced from wells drilled on the Garmesa (Carbonera) anticline is notable for its high carbon dioxide content, which ranges from 20 to 61 percent.

Wellington and Fort Collins. The Wellington and Fort Collins fields, Larimer County, Colorado, have produced both oil and gas commercially. The two pools almost join, end to end, being situated along the same anticlinal structure and separated from each other only by a deep saddle. Each, however, is a separate structure of at least 1,000 ft. closure. The discovery well was completed on the Wellington Dome in 1923 and had an initial open-flow capacity estimated at 82,000,000 cu. ft. per day from the Muddy Sand, the uppermost of the Dakota group of Upper Cretaceous age. This well encountered a primary gas cap, but eventually produced oil, and oil in quantity has since been found at down-dip locations. Though large amounts of gas have been produced, both areas have been exploited primarily for oil. The productive area of the Wellington structure is estimated at 1,000 acres, while that of the Fort Collins structure is about 400 acres.

Up to January 1, 1937, fifteen wells had been drilled in the Fort Collins Field and thirty-one in the Wellington Field. Their 1936 productions were 23,391 bbl. and 95,218 bbl. respectively, while their gross yields to January 1, 1937 were 2,041,700 bbl. for the Fort Collins area and 33,646,200 bbl. for the Wellington area. In 1935, reserves in the Fort Collins Field were estimated at 100,000 bbl. and in the Wellington Field at 581,900 bbl. The oil produced ranges from 35 to 37 deg. in A. P. I. gravity. Transportation of oil from the field is by means of the Colorado and Southern Railway, which passes immediately to the east of the field, and by a branch of the Union Pacific R.R., which passes immediately to the west. Gas produced is treated in the field for its gasoline content, in an extraction plant of 500 gal. daily capacity owned by the Continental Oil Company. A short gasoline pipeline carries the product to Fort Collins. Gas pipelines have also been provided for transmitting gas from the field to Fort Collins and Cheyenne, Wyo.

Florence-Canon City. The Florence-Canon City field, Fremont County, is Colorado's oldest field and the second oldest producing field in the United States. As previously noted, discovery of oil near Canon City was as early as 1862, but commercial production did not begin in the Florence field until 1876. Upwards of 1,200 wells have been drilled in the Florence field since that time and a total of 13,345,000 bbl. of oil have been produced (to January 1, 1937). However, the field is now approaching exhaustion, having yielded only 67,961 bbl. from 105 wells in 1936. The peak of production was reached in 1892. The productive area is 9,000 acres and reserves were estimated in 1935 at 477,000 bbl.

Oil in the Florence field is found in joints and fissures in the Pierre Shale, a formation of Upper Cretaceous age, encountered in the field at depths up to 2,000 ft. The oil is found in a belt three miles wide on the eastern limb of a synclinal basin that lies between two major anticlinal folds. A steep-dipping monocline on the eastern edge of the structure, brings the productive beds to the surface. The gravity of the oil ranges between 30 and 31 deg. A. P. I., and the quoted price in July, 1937, was $0.98 per barrel. Oil from the Florence field was refined for many years in a refinery at the town of Florence, owned by the Continental Oil Company. However, the refinery has recently been dismantled and the production of the field is now shipped to Denver for use in the Continental refinery situated there. The field is crossed by the Denver and Rio Grande Western R.R.

In addition to the Fort Collins, Wellington and Florence-Canon City fields described above, other fields especially worthy of mention in that portion of north-eastern and central Colorado known as the Julesburg Basin, include the Berthoud field in Laramer County, the Boulder Field of Boulder County, the Greasewood Field of Weld County, the North and South McCallum fields of Jackson County, and the Model Dome Field of Las Animas County. All of these have been proven productive but are not regarded as of sufficient importance to justify separate description. The Berthoud Field has been a small producer of both oil and gas since 1929. Boulder is an old field, first exploited in 1902, in which 53 wells have been drilled, but their gross production has been only about 623,000 bbl. and the 1936 yield was only 5,950 bbl. The Greasewood Field is a comparatively new field (1930) in which only three wells are now operating. Their 1936 production was only about 19,000 bbl. In the North and South McCallum Fields, large amounts of gas are produced with a oil, the gas containing about 92 percent of carbon dioxide. The gas comes from the Dakota Sand, encountered here at depths of 4,875 to 5,100 ft. The discovery well in the North McCallum Field, known as the "ice-cream well", blew out when first completed and covered the rig and surrounding land and vegetation for miles around with solid carbon dioxide or dry ice. Difficulty is experienced in completion and operation of wells due to the low temperatures created by expansion of the gas in the flow lines. The Dry Ice Corporation has been experimenting in an effort to commercialize production of dry ice from gas produced in the McCallum fields, but has experienced difficulty in eliminating oil from the product. The Model Dome, Las Animas County, produces gas which contains seven percent of helium and 81 percent of nitrogen. Open-flow capacities of wells range between 1,000,000 and 2,000,000 cu. ft. per day. The Helium Company of Louisville, Kentucky, drilled six wells and built a plant to extract helium from the gas, commercial operations being maintained during 1930, but the plant is now idle.

Chromo Field. The Chromo or Tierra Amarilla field is situated entirely within the boundaries of the Tierra Amarilla Mexican land grant, about five miles north of the New Mexico boundary in Archuleta County, Colorado. The field has only recently been developed by the William E. Hughes Estate, owners of the grant. Thirteen wells have been drilled to produce from the Dakota Formation, some of which have developed initial productions reported as high as 2,000 bbl. per day. Depths of the wells range from 1,200 to 1,600 ft. The oil is of paraffin base and of about 33 deg. A. P. I. gravity. A pipeline of 4,000 bbl. daily capacity has been laid from the field to Chama, New Mexico, where shipping facilities are available via the Denver, Rio Grande and Western R.R. From Chama the oil is shipped for refining to the Continental Oil Company's refinery in Denver.

UTAH FIELDS

The table and map reproduced in Part I shows the locations of nine structures in eastern and southern Utah that have been shown to be petroliferous. However, neither has as yet demonstrated itself to be of sufficient economic importance to warrant separate description in a review of the scope of the present article. Fifty-three wells have been drilled in the Virgin Field in Washington County, discovered in 1907, but their gross production to January 1, 1937, has been only about 157,000 bbl. and 14 of the wells which still produce, yielded only about 3,000 bbl. in 1936. The productive sand is encountered at a depth of only 665 ft.

The San Juan Field, in San Juan County on the Raplee Anticline, discovered in 1909, has also produced a little oil, but its gross contribution has been negligible and the nine wells on the structure are now idle. The Cisco Dome, Grand County, discovered in 1924, is a gas field. It began producing in 1927, and up to February, 1931 when the field was shut in, it had yielded a total of 3,128,000,000 cu. ft. The Farnham Field in Carbon County, the Ashley Valley Field in Uinta County, the Clay Basin Field in Daggett County and the Boundary Butte Field in San Juan County have each produced small amounts of gas, but no oil. In the Ashley Valley district, gas is piped to Vernal, Utah, for domestic use. The Harley Dome in Grand County, produces a gas that yields upwards of seven percent of helium. One gas well completed on this structure had an open-flow capacity of almost 2,000,000 cu. ft. from a formation only 860 to 945 ft. beneath the surface. In the Farnham Field, in 1923, the Utah Oil and Refining Company completed a well to a depth of 3,105 ft. producing 12,000,000 cu. ft. of non-combustible gas daily, under a formation pressure of 960 lb. per sq. in. The gas is 98.3 percent carbon dioxide and is found in the Coconino Sandstone of Permian age, at a depth of 3,093 ft. The Carbon Dioxide and Chemical Company has installed a small dry ice plant at Price, a few miles distant, operate on gas from the Farnham Field.

A well completed on the Woodside Anticline, Emery County, Utah, had an initial open-flow capacity of 9,000,000 cu. ft. daily of helium bearing gas from the Coconino Sandstone, here encountered at depths ranging from 3,120 to 3,165 ft. The helium

content is reported to be 1.3 percent and the formation pressure about 900 lb. per sq. in. The gas also contains about 62 percent of nitrogen. The structure has been designated as a helium reserve by the federal government.

The gross recorded oil production of Utah fields, up to January 1, 1937, has been but 168,000 bbl. At that time, only 14 oil wells and 11 gas wells were producing in the entire state. Gas production to date has been estimated at 4,197,200,000 cu. ft. Oil reserves are thought to be negligible, there being but 610 acres of and regarded as proven.

NEW MEXICO FIELDS

The oil and gas fields of New Mexico can be conveniently classified into two geographical groups. These are: 1. The San Juan Basin Fields of north-western New Mexico, and 2. The Lea and Eddy County Fields in the south-eastern corner of the state. Scattered exploration has also been under way in the north-eastern portion of New Mexico, but up to the present time, without discovery of oil or hydrocarbon gas fields of economic importance. Substantial production of oil has been obtained in the north-western area from the Rattlesnake and Hogback Fields and comparatively small amounts from the Table Mesa and other less important fields, all in San Juan County. Other structures shown on the map reproduced in Part I (August World Petroleum) have been shown to contain oil and gas, but in amounts that do not justify commercial exploitation at present. The greater part of New Mexico's oil and gas production has been obtained from the Lea and Eddy County fields, and intensive development activity is still under way in this section. Here are situated a number of important oil fields, including the Hobbs, Eunice, Cooper, Jal, Lea and Monument Fields in Lea County, and the Artesia District including the Artesia Field and several smaller elated pools in Eddy County.

Total oil production in New Mexico, from the time of the first recorded production in 1922 to January 1, 1937, has been 121,316,600 bbl. Production has lately been increasing and reached a peak of 26,804,446 bbl. in 1936. Total recorded gas production to January 1, 1937, was 206,427,000,000 cu. ft., of which 72,361,500,000 cu. ft. was produced in 1936. Prior to 1937, a total of 1,625 oil and gas wells were drilled in New Mexico, of which 1,385 were producing in 1936. Of the latter group, 1,146 were producing oil only, 33 were producing gas only and 206 were commercially productive of both oil and gas. The total proven productive area is 59,165 acres, of which 5,245 acres produces gas only. Aggregate New Mexico reserves were estimated by U.S. government agencies, as of December 31, 1933, at 92,500,000 bbl. Discovery of new pools and extensions of old pools since that time, chiefly in the Lea and Eddy County District, has increased the apparent reserve, though upwards of 70,000,000 bbl. of oil have meanwhile been produced.

Rattlesnake. Rattlesnake field, San Juan County, was discovered in 1924. Situated on a large elongated dome cut by minor faults, wells in this field produce from two horizons: the Dakota Formation, oil-bearing and highly lenticular sands of which are encountered at depths ranging from 700 to 900 ft., and the deeper Pennsylvanian beds at about 6,770 ft. Oil produced from the Dakota sands is light amber in color and unusually volatile, ranging as high as 76 deg. in A. P. I. gravity. The oil in the formation is under a pressure of 270 lb. per sq. in. and contains large percentage of ethane, propane and butane in the liquid phase. These constituents tend to vaporize when pressure is reduced as the oil reaches the surface, and refrigeration effects resulting from the evaporation of these light fractions are responsible for complications in production, storage and handling of the crude. To reduce excessive evaporation loss and difficulties in pumping through pipelines, the oil is passed through a stabilizing plant which removes and condenses the very volatile fractions, leaving a residue of oil of about 59-60 gravity, having comparatively low vapor pressure. The gasoline yield of this product by straight distillation, is 75 percent and the yield of kerosene distillate is 14 percent. Oil in the Pennsylvanian Formation is heavier, being about 42 gravity. This oil yields about 41 percent of gasoline and 11 percent of kerosene distillate.

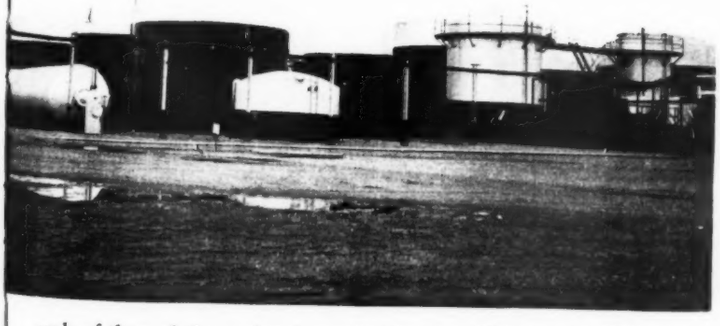
Up to January 1, 1937, the 43 wells completed in the Rattlesnake Field produced 3,527,600 bbl. of oil. At the close of 1936, 28 wells were producing and their yield for the year was 278,293 bbl. Reserves of oil in this field were estimated in 1935 at 3,584,000 bbl. Properties in this field are operated by the Continental Oil Company and the oil is shipped via pipeline through the near-by Hogback Field, to Farmington, where the Continental Oil Company operates a 600 bbl. refinery. This refinery supplies most of the gasoline used in its immediate area. The Continental Oil Company also operates a pipeline which extends south to Gallup, McKinley County, where shipping facilities via the Santa Fe Rail Road are available.

Hogback. Hogback Field, San Juan County, is situated on a large dome, only 160 acres of which are productive. The oil-yielding formation is the Dakota Sand of Upper Cretaceous age, which is here reached by wells averaging 725 ft. in depth. The productive formations are highly lenticular. First production was obtained in 1922, and from this time until January 1, 1937, the 15 wells drilled in the field produced a total of 1,741,429 bbl. The seven wells producing during 1936 yielded 84,657 bbl. Oil produced in this field, like that of the Rattlesnake Field, is of unusually high gravity, averaging about 60 deg. A. P. I. Straight distillation of this paraffin base crude yields 74.5 percent of gasoline and naphtha and 13 percent of kerosene distillate. The sulphur content is less than 0.1 percent. Reserves of oil in the Hogback Field were estimated at 330,000 bbl. in 1935.

Oil from the Hogback Field is shipped by a pipeline owned by the Stanolind Oil and Gas Company to Farmington, New Mexico, from which point it is shipped by rail, via the Denver and Rio Grande Western R.R., to the Salt Lake City refinery of the Utah Oil Refining Company. Other small refineries operating on oil produced from the Hogback, Rattlesnake and other fields of the San Juan Basin District, are situated in the near-by towns of Aztec and Bloomfield.

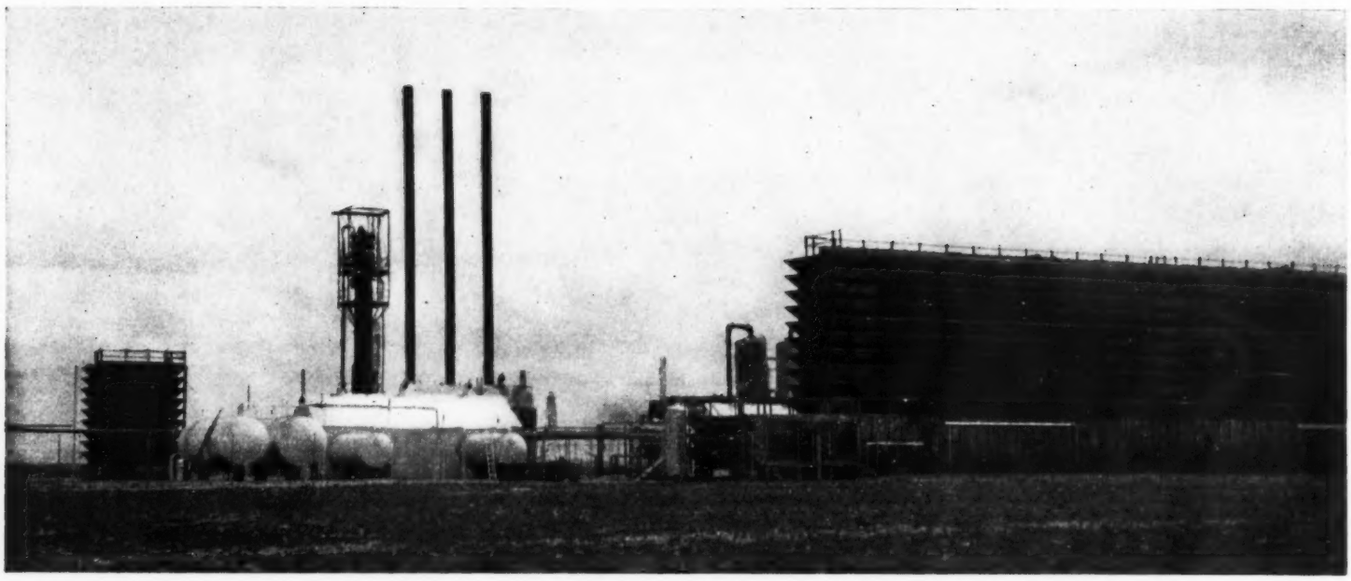
Other oil and gas fields of the San Juan Basin Area, in north-eastern New Mexico, include the Aztec-Bloomfield, Table Mesa, Blanco and Kutz Canyon Fields, all in San Juan County, and the Hospah and Red Mountain fields in McKinley County. Production in each of these fields has thus far been too small to justify special description. Their aggregate production up to January 1, 1937, has been only about 450,000 bbl. of oil and their total 1936 production was but 30,700 bbl. from 29 wells. Their combined oil-productive area is estimated at 280 acres. The Kutz Canyon and Ute Dome Fields are gas producing areas of about 1,200 and 640 acres respectively. Up to January 1, 1937, the Kutz Canyon Field produced about 5,474,000,000 cu. ft. of gas, 1,192,000,000 of which was produced in 1936. The Ute Dome produced a total of 3,248,000,000 cu. ft. prior to 1937, 447,500,000 of which was produced in 1936. A gas pipeline system connects this field with the cities of Farmington, Albuquerque and Santa Fe in New Mexico, and the town of Durango in south-western Colorado.

Permian Basin Fields. The most important oil-producing district in the five Rocky Mountain states included in the present survey, from the stand-point of present producing capacity, visible reserves and current development activity, is that portion of the Permian Basin area lying within Lea and Eddy Counties, in south-eastern New Mexico. Here, some twenty-odd producing areas have been developed, some of which are so closely related that they sacrcely appear to be separate pools when located on a map of the



Views of Continental Oil Company's refinery, showing tankage, treators and cracking plant.

scale of that of the regional map in Part I. These fields are much alike in their geological characteristics and in the methods employed in exploitation, so that descriptions of the three largest and economically most important of the group will serve for all. In Eddy County, the Artesia, Grayburg, Jackson and Maljamar pools comprise a closely related group, distributed along an east-



There are few natural-gasoline plants in the Rocky Mountain States; one of the largest is that of Phillips Petroleum Corp., at Hobbs, New Mexico.

west trending anticline. On the north flanks of this same structure are two gas-producing fields: the Vandergriff Field and the Leonard-Levers Field. Somewhat to the south, on another structure, is the comparatively small Getty Pool.

In Lea County, apparently on an extension of the same structural feature responsible for the Artesia-Maljamar pools, are the Vacuum and Hobbs pools, the latter being one of the most important and best known of the producing areas in this district. To the south and south-east of the Hobbs field, are a series of important, closely related fields disposed along a north-south trend. Included in this group are the Monument, Eunice, Lynn, Cooper, Jal and Eaves pools. In all of these areas, production is secured from limestone reservoirs. A few miles to the east of this group is another series of small and comparatively unimportant pools, apparently disposed along another approximately north-south line. These are the Hardy, Penrose, Skelly, Mattix, Langlie and Rhodes pools. Production in these areas is from sandy lime. Somewhat to the west of the Monument and Eunice fields, on a structure that is probably the same or closely related with that on which the Getty pool in Eddy County is situated, are two other Lea County fields; the Lea and Empire pools.

Geologists are not in agreement on the structural conditions controlling formation of these pools. However, they all seem to be related to what has been called the "Central Basin Platform," a shelf, reef or shore line forming a portion of the rim of the "Delaware Basin." The latter is a sink or depression in the south-western portion of the Permian Basin, a larger structural feature which occupies a large part of west Texas and south-eastern New Mexico. All of the oil and gas fields in south-eastern New Mexico, as well as those further south in west Texas, lie along the strike of the Central Basin Platform.

Most of the more prolific fields derive their production from the upper portion of a massive porous limestone and dolomite formation that is known to be at least 2,000-ft. thick in south-eastern New Mexico. Associated with the limestone are thin beds of sand and lenses of organic or lignitic shales rich in organic matter, that are thought to be the source of the oil. Accumulation of oil within the limestone is determined largely by local variations in porosity. Production is not secured from a continuous bed or stratum, but rather from porous portions of the limestone that seem to pinch out laterally and to vary in their vertical depth below the top of the formation. Along the eastern rim of the Central Basin Platform, the limestone is overlain by sandy lime strata that are oil-bearing. In some of the producing areas, strata above the main limestone formation are also productive of oil and gas.

Artesia-Maljamar District. The first commercial wells were drilled in the Artesia-Maljamar district, Eddy County, New Mexico, late in 1923. It was the first productive area in the eastern half of New Mexico. Since that time, up to the beginning of 1937, 376 wells were completed and 7,265,400 bbl. of oil produced. The proven, developed oil-producing area is 10,660 acres and the gas-producing area, 2,840 acres. Average depth of the wells is 2,251 ft. Production is from the upper 300-ft. of the San Andreas Formation, of Permian age, the reservoir rock being a sandy dolomite. As explained above, the district includes several pools to which separate names have been assigned: specifically, the Artesia, Getty, Jackson and Maljamar pools and the Leonard-Levers and Vandergriff gas fields.

Production throughout the area is erratic, being dependent upon local porosity of the limestone, which is highly variable. Wells are inexpensive, requiring only one or two strings of casing. All are shot with high explosives before being placed on production. The oil produced is of paraffin base, of about 37 deg. A.P.I. gravity, contains about 0.9 percent of sulphur and yields 40 percent of gasoline by straight distillation. Parts of the area support commercial gas wells. The original formation pressure is estimated at from 1,000 to 1,200-lb. per sq. in. The wells are short-lived and already have declined to low rates of production. It is believed that reserves of oil and gas for future exploitation in this district are comparatively small, though definite figures have not been available to the writer.

Oil is transported by pipeline to Artesia, where three refineries are situated. Their combined capacity is 4,000 bbl. Petroleum products are distributed from these refineries to local markets in the surrounding region, primarily by means of tank motor trucks. Gas produced in the district is transmitted by pipeline to Artesia, Carlsbad, Hagerman and Roswell.

Hobbs Field. This field, located in Lea County, New Mexico, was the first major discovery in south-eastern New Mexico and its highly successful and profitable exploitation served to focus attention on the district, leading to other important dis-

coveries in the same locality. The structure, an elongate dome of irregular contour, was located by geophysical methods. The discovery well was completed in November, 1928. From that time until January 1, 1937, 258 wells were drilled and 73,579,400 bbl. of oil were produced, with 112,146,000,000 cu. ft. of gas. The field limits are now defined, the productive area being 9,760 acres. Exploitation of the field has been systematically conducted, using a uniform spacing interval of 40-acres per well.

In reaching the top of the principal oil-producing formation—the "White Lime"—wells must penetrate about 1,000 ft. of potash-bearing salt; the "Brown Lime," used as a marker throughout the field; the "Big Gas Pay" and the "Bowers Sand." The latter two divisions are of commercial interest, but are not exploited by present wells. The Big Gas Pay, which is encountered at about 3,700-ft., yields large flows of high-pressure gas and blow-outs must be guarded against in drilling through it. One well gauged more than 50,000,000 cu. ft. of gas daily from this horizon, after flowing open for several days. The Bowers Sand, encountered at a depth of between 3,175 and 3,220-ft., yields gas and light oil (37 deg.-40 deg.) of paraffin base. In one well where the Bowers Sand was tested, it was shown to be capable of producing 234 bbl. of oil and 1,500,000 cu. ft. of gas daily. The White Lime, from which all present production is derived, is a limestone of Permian age, encountered at a depth of 4,050 ft. In this, there are three different pays. The upper ten to thirty feet of the White Lime is very dense and hard and serves as a cap rock for the highly permeable and porous reservoir zone which lies immediately below.

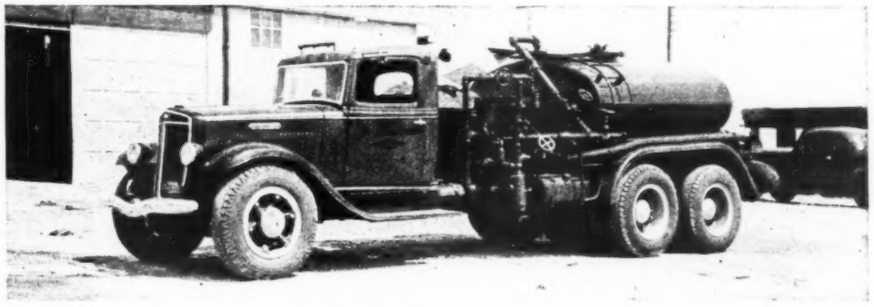
Except for a few of the early wells which were drilled with cable tools, drilling in the Hobbs Field—as well as in all other fields in Lea County—has been with rotary equipment. No unusual drilling problems are encountered. State conservation authorities prescribe a definite casing and cementing programme, designed to protect supplies of fresh water and potash and the oil and gas horizons above the White Lime that are cased off. Contractors do most of the drilling, costs ranging from $4 to $5 per foot. Completed wells cost from $40,000 to $50,000, averaging about $42,500. The average depth of wells is 4,174-ft.

Though the field is fully developed, most of the wells still flow their production. At the beginning of 1937, only 15 wells were pumped and three were on gas-lift. Initial open-flow productions have been as high as 20,000 bbl. per day and most of the wells were capable of producing more than 5,000 bbl. per day when first completed. Due to a rigorous programme of production control, formation pressures are but a few hundred pounds less than the original reservoir pressure, which was slightly in excess of 1,500 lb. per sq. in. At 1,300 lb. pressure, the oil in the reservoir contained in solution about 700 cu. ft. of gas per barrel. Gas-oil ratios have ranged from 900 to more than 2,000 cu. ft. per barrel, depending upon the rate of production. All wells produce through three-inch tubing, with suitable chokes. The gas produced ranges from 0.5 to 2.3 gal.per thousand cubic feet in gasoline content, depending upon the trap pressure maintained. The oil gravity ranges from 33 to 37 deg. A.P.I. It is of mixed base, approaching asphaltic in character, and yields 37 percent of gasoline by straight distillation. Sulphur content of the crude is 1.15 percent. The quoted price of Hobbs oil in August, 1937, ranged from $0.78 to $1.08, depending upon the gravity.

Acid treatment of wells is widely practiced in the Hobbs Field and is highly successful in increasing well potentials. However, the formation is naturally very permeable, and the necessity or desirability of acid treatment under the conditions presented, has been questioned by some who believe that it has hastened water encroachment. Water encroaches about the perimeter of the field as the oil and gas are withdrawn, particularly on the south-west flank of the structure. Emulsification of the oil is not a serious problem and oil-water mixtures separate by gravity settling with moderate heat treatment.

Estimates of the gross ultimate recovery of the Hobbs field have recently ranged from 147,000,000 to 177,000,000 bbl. If the lower figure be accepted, the remaining reserve available for future production, is about 74,000,000 bbl. Zavoico (WORLD PETROLEUM, August, 1935) has estimated gross profits in exploitation of this field at about $114,000,000. The Hobbs Field, as well as others in Lea County, is heavily pro-rated. The potential production capacity credited to the field on July 1, 1937, was 2,155,900 bbl. per day, and the allowable daily production only 20,000 bbl. Allowable production of individual producers is computed on a combined acreage and potential basis, allowing 75 percent to well potential and 25 percent to acreage.

Oil is shipped from the Hobbs Field through three pipelines which connect with pipeline systems serving other fields of the Permian Basin in west Texas. There is only one small local refinery in New Mexico handling crude from the Hobbs field. The gas produced is processed in two gasoline extraction plants of absorption type, one owned by the Phillips Petroleum Company having a daily capacity of 40,000 gal. and the other a 30,000 gal. plant owned by the Continental Oil Company. Dry gas from these plants is used in



Above: Acidation of wells is finding widespread use in limestone fields—Dowell service truck at Hobbs, N. M., headquarters. Below: The name Halliburton is familiar to operators throughout the Rocky Mountain region—service trucks at Monument, N. M., headquarters.

the near-by towns of Hobbs and Lovington and for field fuel. Excess gas above these requirements is burned in the field.

Monument-Eunice Fields. These two fields also in Lea County, formerly thought to be separate pools, have in the course of their development, almost merged and can be conveniently considered together. If regarded in this way, they jointly constitute the largest field and have the largest reserves available for future exploitation of all of the fields of the Rocky Mountain region. The Eunice area was first developed, the discovery well being completed in March, 1929. The first well in the Monument area was completed in February, 1935. Prior to January 1, 1937, 378 wells were completed in the Eunice area and their total production was 13,458,000 bbl. of oil and 30,055,000,000 cu. ft. of gas. On this same date, the Monument area had 268 producing wells and had produced 3,817,300 bbl. of oil and 8,409,000,000 cu. ft. of gas. Forty additional wells were also in process of drilling. The proven productive area of the Eunice portion of the field, was 14,600 acres, while that of the Monument area was 10,520 acres.

Ultimate oil recoveries cannot be forecast on other than an approximate basis, but have been estimated at 200,000,000 bbl. for the Eunice area and 175,000,000 bbl. for the Monument area.

Subsurface conditions and field development and production methods in the Monument-Eunice fields are closely comparable with Hobbs, described in greater detail in the preceding section. The White Lime producing horizon however, is found at 3,800 to 4,000 ft.: somewhat less than in the Hobbs field. The gravity of the oil is slightly lower, ranging from 32 to 36 deg. A.P.I. Five oil pipelines are available, connecting the field with the west Texas pipeline systems. Gas produced with the oil is processed in two absorption plants, one in the Monument area having a capacity of 50,000 gal. daily, and the other, a 25,000 gal. plant, in the Eunice area.

EXPLORATION ACTIVITY

Most of the fields thus far developed in the Rocky Mountain region are situated on well defined structures that are clearly apparent from surface geological indications. Much of the area, particularly around the rims of the basins, is open country, comparatively free of vegetation and detrital material, and presenting excellent surface exposures from which the subsurface structural conditions can be readily deciphered. Within the basins however, at points remote from the rims where accumulated sediments are deep, the local structural features are not readily inferred from surface information easily available.

Detailed areal studies of portions of the region have been made by geologists in the employ of the oil companies and the federal and state bureaus during the last twenty years. A wealth of information is available to any one interested in gas or oil development particularly from the U.S. Geological Survey which has concentrated much of its effort in recent years in this region. A large part of the unappropriated land on the public domain lies within the Rocky Mountain states and the problems of land classification and supervision of leasing operations under the federal mineral land leasing laws, has been delegated to the U.S. Geological Surgey. The Survey maintains regional offices and technical staffs for this service in several centers. Many of the Survey maps and records are concentrated in the Casper, Wyoming, Denver, Colorado, Roswell, New Mexico and Salt Lake City, Utah, offices where regional headquarters have been established for field personnel. Field offices of the U.S.G.S. are also maintained at Billings and Shelby, Montana; at Midwest and Thermopolis, Wyoming; and at Farmington, New Mexico. At Midwest, Wyoming, the Survey maintains a field laboratory for inspection, testing and preservation of formation and oil samples. The U. S. Bureau of Mines also maintains laboratories and a technical staff for work on oil industry problems at the University of Wyoming, Laramie, Wyoming. While much of the work of this latter organization relates to production and refining technology, some of it is of value to operators interested in exploration and field development. Most of the oil company geological and land and lease department staffs have their regional headquarters at either Denver or Casper. While oil company geological work is generally held confidential, much of it has been summarized in numerous excellent papers that are available to any one interested, in the Bulletin of the American Association of Petroleum Geologists and various special volumes.

In exploring areas within the structural basins, in localities where deposition of sediments has obscured the sub-surface recourse has been had during recent years to use of geophysical methods. Many operators apparently feel that most of the favorable structures that can readily be identified by surface areal studies, using ordinary methods of geological exploration, have already been found, and that most of the future discoveries will be made with the aid of geophysical survey methods. Thus far, the reflection seismic method has been most used, several of the major oil companies operating in the region having actively pursued exploration programmes by this means during the last three years. Geophysical work in the region thus far, has been widespread, there being comparatively little duplication of surveys except in eastern Colorado, where of late the exponents of this method of exploration have been most active. At times within the last two years, nearly 4,000,000 acres of land have been under lease to various oil companies for oil and gas exploration and development purposes in eastern Colorado. The Gypsy, Texas, Magnolia, Indian Territory, Continental, Ramsey, California and Stanolind Companies have been particularly active in supporting geophysical work and acquiring leases in eastern Colorado. Efforts have been made in most cases, to acquire large blocks in order to achieve unified control of any pools that may be found. It has been estimated that between $10,000,000 and $20,000,000 have been expended in the eastern Colorado play, in making surveys and acquiring leases, and that as much more must be expended during the next few years in drilling test wells and meeting other lease obligations. Other geophysical parties in the field during recent months, have been working in the Green River Basin of northwestern Colorado and in the Powder River, Sand Wash and Big Horn Basins in Wyoming. In each case, interest has attached to the possible existence of folds buried beneath the deeper sediments at points remote from the rims of the basins of deposition.

In past years, many hundreds of wildcat wells have been drilled in areas that were found to be non-productive. Many of these projects were ill advised and should never have been drilled; but in other cases, dry holes have been drilled on what seemed to be very promising structures. In some instances, production was secured but wells were not sufficiently productive to encourage further development; or the oil was of a grade not in local demand. Inaccessibility and lack of transportation facilities have operated to delay development of some fields in which the initial wells displayed substantial production. In many cases, wells thus far drilled have tested only the upper horizons.

Much of the current exploration activity is in drilling for possible production in deeper formations on structures previously productive from shallower depths. The remarkable persistence over wide areas of some of the principal oil and gas-producing formations, gives promise that where these deeper formations are productive in one field, they may also occur and be found productive in other fields. There are many structures in Montana and Wyoming where only the upper horizons have been tested and where excellent opportunities exist for development of new production at greater depths. The Sundance and Tensleep formations and the Madison Lime are of

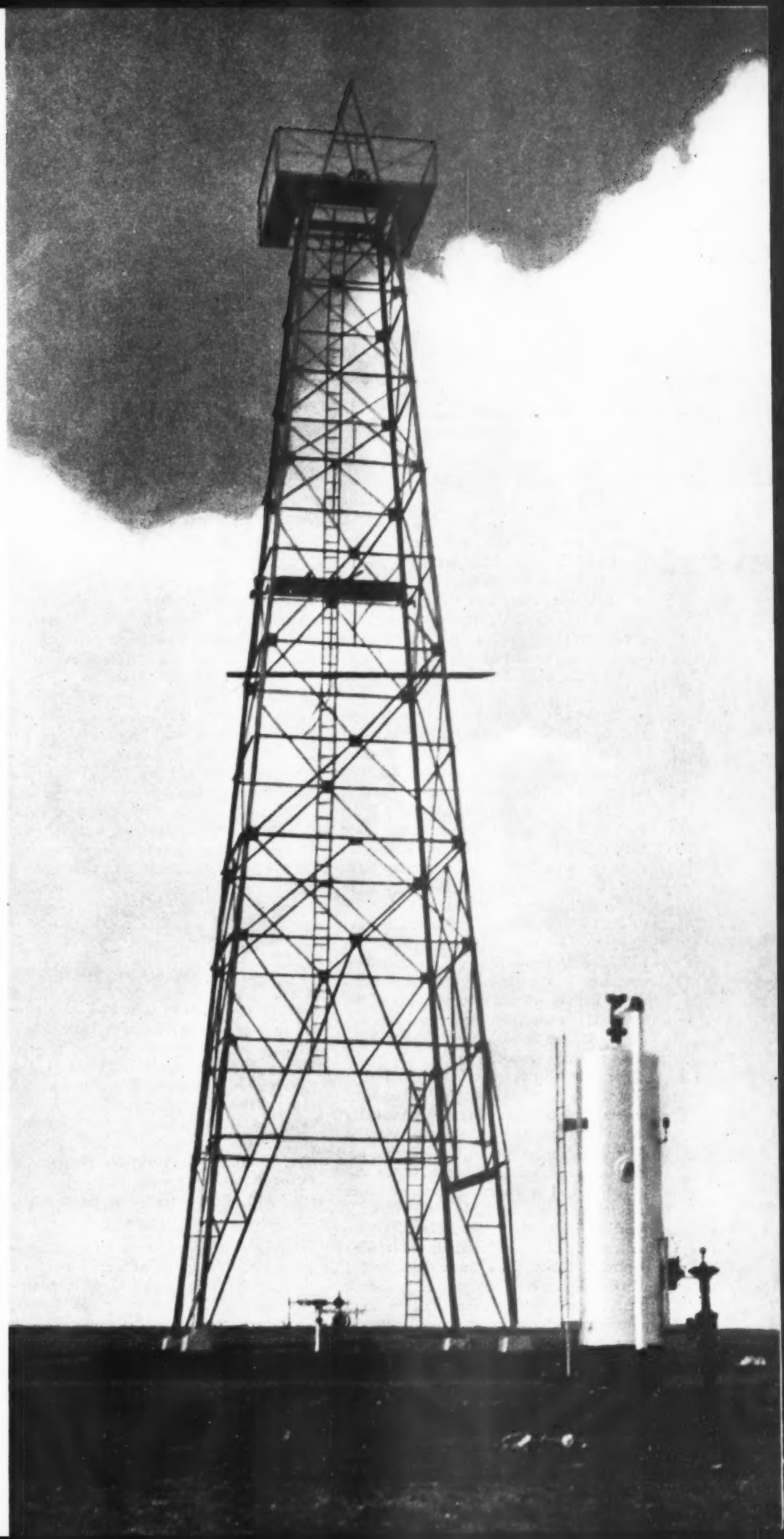
particular interest in this connection in many prospective areas. Of the many fields in Wyoming, only eight have been tested by wells that have penetrated the Madison Lime, deepest known productive formation in this state.

The Rocky Mountain region, because of its isolation, will probably be the last of the great petroleum provinces of the United States to be intensively exploited. Nevertheless, forward-looking oil company executives have been seeking to locate and conserve new reserves in this region in anticipation of a possible shortage of the supply in other, at-present, more intensively exploited regions. However, there is at present in the region, much shut-in production awaiting this future need, particularly in the so-called black-oil fields.

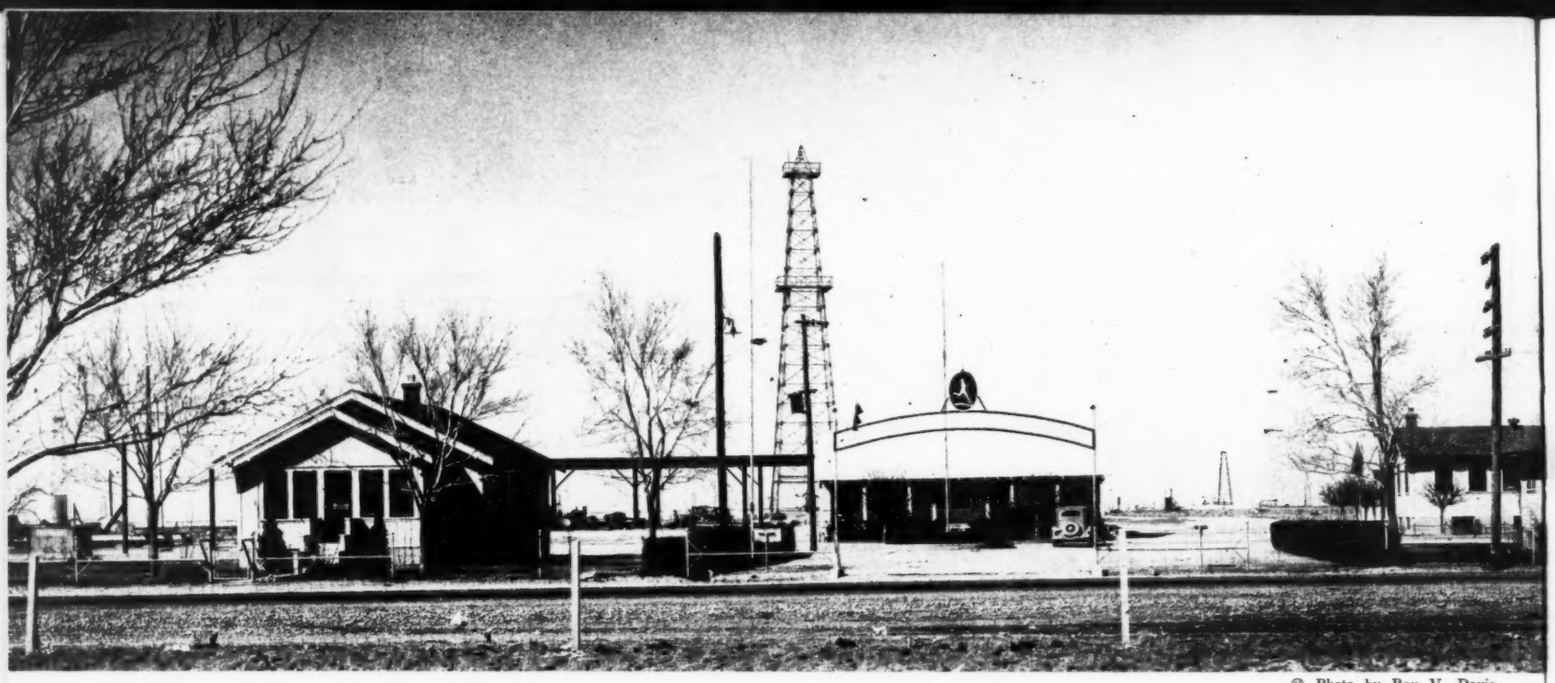
FIELD DEVELOPMENT METHODS

Until a few years ago, practically all of the drilling in the Rocky Mountain region, was by the cable-tool method. In shallow territory portable outfits were used and where these proved inadequate, the American standard cable-drilling rig was employed. The latter is capable of drilling with fair speed and at reasonable cost, to depths well in excess of any that were necessary in penetrating the shallower formations exploited during the earlier years. Some of the formations that must be penetrated to reach the oil-bearing horizons are hard, and earlier types of rotary bits made slow progress in drilling them. In shallow drilling, costs were higher with rotary tools than with cable tools and hence operators looked with disfavor on the rotary method. The Rocky Mountain region was regarded as one of the last strong-holds of the cable driller in America and it was thought that the field conditions presented in this region would perhaps justify continued use of the cable method. However, with the development of hard-rock rotary bits and the necessity for deeper drilling in many of the Rocky Mountain fields, operators have looked with greater favor on the rotary method and have used it extensively for much of the more recent drilling.

Rotary rigs of the same general type as that so widely used throughout the Mid-continent and Gulf Coast regions, are now commonly employed in the more active Wyoming fields: notably, in the Lance Creek, Medicine Bow, Byron, Garland, Qualey, Badger Basin, Oregon Basin and Billy Creek Fields. Practically all of the drilling in south-eastern New Mexico has been by the rotary method. However, a substantial number of cable-tool wells are



Modern equipment at a flowing well in the Monument Field, New Mexico.



© Photo by Roy V. Davis

Ohio Oil Company's headquarters camp, Hobbs, New Mexico.

drilled each year in some of the more important shallow fields, such as the Cut Bank and Kevin-Sunburst fields in northern Montana. In Wyoming, during recent months, about five rotary rigs have been in use for each cable rig, and because of the greater rapidity of rotary drilling, there have been about fifteen completions with rotary tools for each completion with cable tools.

The deepest producing wells thus far completed in the Rocky Mountain region are in the Badger Basin field, where the producing formations lie at a depth of about 8,500 ft. There are two producing wells in this field, one completed with cable tools—a very deep well for this method—and the other with rotary tools. Two additional wells are soon to be drilled by the rotary method. The deepest rotary-drilled well in the region up to the present time, is a dry hole drilled by the Amerada Petroleum Corporation, near Cheyenne, Wyoming, to a depth of 9,380-ft. Most of the wells are drilled by contractors at costs which of course, increase with depth and inaccessibility of the location, but which have averaged approximately $15 per foot for the 4,000 to 6,000 ft. holes recently drilled.

For rotary drilling, steam equipment is almost exclusively used. Two insulated boilers and a super-heater designed for steam pressures up to 300-lb. are placed at each well. Vertical two-cylinder steam engines are preferred. Oil is hauled to the well for boiler fuel in wildcat operations, where natural gas is not available. Boiler water is plentiful in most localities. Derricks are customarily of structural steel, 122-ft. high —rarely, 136-ft. The formations drilled require almost continual use of hard-rock bits. The sandy formations are hard and abrasive and the plastic shales and red beds cause tracking of bits. Light bit pressure must be used to avoid crooked holes. The limestones are hardest of all, progress being limited to only six inches per bit in extreme cases. Casing programmes are simple and comparatively inexpensive. In the Byron region, for example, a conductor string of only 350 ft. is all that is needed and a seven-inch oil string can be landed inside this at 5,000 ft. The tendency is to drill holes of only moderate diameter, 9 inches, 8¼ inches or even 7⅝ inches being common. Water exclusion is not difficult.

Cold weather and inaccessibility are important handicaps in the conduct of development work in some parts of the region. Roads are kept open throughout the year to the more accessible fields near the main highways, but roads to some of the more remote areas are almost impassable with heavy equipment throughout most of the winter months. January, February and March are the more difficult months of the year from the transportation standpoint.

For the most part, the fields of the Rocky Mountain region have been conservatively developed, the highly competitive situations that have been characteristic of some fields in other regions being notably absent. Ten-acre spacing has been common in many of the older fields, but in some of those more recently developed as much as forty acres to the well have been allowed. In some fields, exploitation is practically unitized by cooperative agreement.

(To be concluded)

HOLLAND and Oil Trade

LEADING American industrial and banking interests are joining with Dutch companies in a move to develop closer business relationships between United States and the Netherlands. For this purpose the Holland House Corporation of The Netherlands has been organized in New York with offices in the International Building, Rockefeller Center, New York, N. Y., pending arrangements for a permanent office. An office will also be opened in Amsterdam, Holland.

Among the important oil men associated with this movement are:

George S. Walden, chairman, Standard-Vacuum Oil Company; W. S. Farish, president Standard Oil Company (New Jersey); Henry R. Doherty, president, Cities Service Company; R. G. A. van der Woude, president, Shell Union Oil Corporation; D. Pyzel, vice-president, Shell Union Oil Corporation; H. Dundas, vice - president, Standard - Vacuum Oil Company; W. Alton Jones, first vice-president, Cities Service Company; J. E. Crane, assistant treasurer, Standard Oil Company (New Jersey); J. L. Quinn, New York manager, Standard Oil Company of California; J. A. de Lanoy, purchasing director, Asiatic Petroleum Company; F. B. Loomis, Standard Oil Company of California; Floris W. ter Meulen, Cities Service Company.

Many well-known executives of other American industrial organizations also have become associated with the project.

▼

FIGURES revealing the decline of exports of petroleum products from Soviet Russia, and the great increase in domestic consumption, are given in the U.S.S.R. department of this issue of WORLD PETROLEUM.

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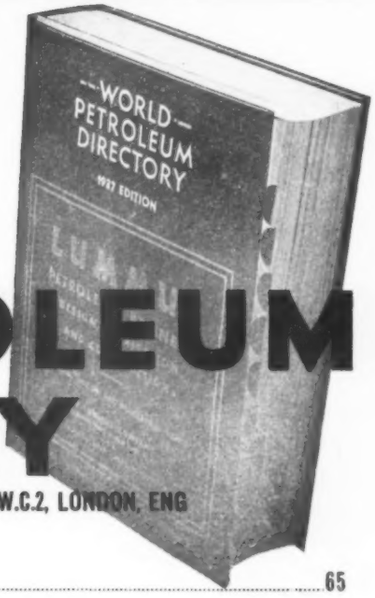

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Foreign Oil Legion

GORDON H. MICHLER, advisor on South American petroleum affairs to the International Association (Petroleum Industry) Ltd., London, has been visiting Brazil and the Argentine. One of the problems which faced Mr. Michler in Brazil was the continued shut-down of the new refinery built by Jersey Standard prior to the new law which limits the ownership and operation of oil refineries to citizens of Brazil. Mr. Michler is a member of the council of the Association.

B. P. NEWTON, vice-president of overseas marketing operations of the Gulf Oil Corporation, sailed for London on August 17 on the NORMANDIE. From England Mr. Newton will visit the company's various offices in Continental cities.

I. G. LAIDLAW, technical advisor to the chief engineer of Trinidad Leaseholds, Ltd., arrived in New York, August 20th where he spent several days. He had flown by plane from Trinidad .He is now on a tour of the Mid-Continent, inspecting current drilling practice.

JOSEPH CHARLTON, Californian petroleum engineer, jumped overboard to swim ashore from the Colonial liner COMET in the East River, New York, when he found that his wife and self could not get sleeping accommodations. He was picked up by the crew of a motorboat. Having several days to spare before sailing to Europe on the ss. BREMEN, Mr. and Mrs. Charlton had thought they would take a trip to Providence. It is to be hoped that there was a stateroom on the BREMEN for them.

A. R. OGSTON, who for some years was associated with the International Paint and Compositions Company Ltd., London, in connection with oil industry paint problems, has been appointed assistant technical supervisor at the London office of International Aviation Associates, which is the coordinating organization handling affiliation of interests as regards the sale of aviation gasoline and lubeoils by Intava. The latter company was recently formed by the Jersey Standard and Socony-Vacuum groups.

Dr. W. P. Haynes of the Jersey Standard has talents other than that of geology. He recently took part in a pageant commemorating the one-hundredth anniversary of Boxford Church, Mass., acting the part of 'the good neighbour'.

CAPTAIN J. W. FLANAGAN recently returned to his home in Toronto, Canada, after a month's trip to Colombia. He left New York July 21st, flying via Texas and Mexico to Panama and Bogota, Colombia, attending social functions in connection with the Inauguration of President Santas. On the 11th Captain Flanagan returned to Cartagena, Havana, Miami and New York.

William J. Haley is an important link in international oil operations, being assistant general manager in charge of the South American and European refineries of Standard Oil Company of New Jersey (Del.) He is a graduate engineer of the University of Pennsylvania and entered the petroleum business in 1914, joining the general engineering department of the Standard Oil Company (N. J.); but during the World War he served in the U. S. Navy. During the years after the armistice, Mr. Haley was located at the Bayway refinery, Elizabeth, N. J.; Baton Rouge, La.; Charleston, S. C.; and Havana, Cuba, and finally at the New York office where he ably assists G. W. Gordon, director of overseas refineries.

WORLD OIL PRODUCTION—Official Figures

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise specified—Table revised monthly

(Figures in U.S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries)

	August 1937	September 1937	October 1937	November 1937	December 1937	January 1938	February 1938	March 1938	April 1938	May 1938	June 1938	Preliminary Figures July 1938
United States	115,090,000	109,980,000	110,911,000	104,206,000	106,579,000	106,007,000	94,662,000	106,524,000	102,702,000	98,674,000	94,176,000	103,100,000
Russia[2]	17,183,259	16,663,000[1]	17,600,000[1]	16,923,000[1]	17,600,000[1]	17,647,000[1]	13,591,000[1]	15,984,000[1]	17,850,000[1]	17,580,000[1]	18,540,000[1]	18,200,000
Venezuela	17,861,784	17,640,872	17,979,227	17,044,016	17,096,298	15,271,901	13,792,479	15,109,040	13,696,219	15,994,400	16,302,150	16,100,000
Iran[3]	7,313,264	7,198,034	7,075,122	6,821,616	5,999,642	5,907,458	6,414,470	8,284,215	7,090,486	6,975,256	6,853,000[1]	6,920,000
Netherland India	4,672,953	4,586,638	4,766,689	4,626,395	4,671,582	4,245,587	4,235,422	4,721,147	4,568,899	4,764,193	4,573,726	4,518,455
Roumania	4,293,000	4,256,000	4,313,000	4,162,000	4,198,000	4,099,000	3,751,692	4,182,000	4,090,000	4,169,000	4,015,000	4,120,000
Mexico	2,800,868	3,432,101	4,372,808	4,211,293	4,349,415	4,141,977	4,017,000†	900,000†	700,000†	1,700,000‡	1,800,000†	2,000,000
Iraq	2,429,787	2,513,145	2,663,244	2,645,099	2,431,532	2,670,844	2,385,464	2,717,278	2,592,996	2,332,746	2,653,579	2,806,903
Colombia	1,592,592	1,617,433	1,811,759	1,797,625	1,824,956	1,784,638	1,508,487	1,841,882	1,616,684	1,804,111	1,810,049	1,803,143
Peru[4]	1,494,467	1,453,712	1,492,971	1,432,508	1,481,701	1,365,152	1,340,000[1]	1,474,364	1,296,090	1,343,259	1,303,536	1,335,623
Argentina	1,345,513	1,369,767	1,360,000[1]	1,365,000[1]	1,370,000[1]	1,378,000[1]	1,289,000[1]	1,380,000[1]	1,349,000[1]	1,382,000[1]	1,346,000[1]	1,349,000
Trinidad	1,433,474	1,358,600	1,393,317	1,300,485	1,349,908	1,378,021	1,304,819	1,438,436	1,418,825	1,481,285	1,431,476	1,500,171
Burma[5]	679,335	701,066	704,736	631,584	640,195	616 522	496,306	633,644	637,000[1]	652,000[1]	635,000[1]	638,000
Bahrein[6]	254,937	662,861	847,988	749,354	805,236	805,800	707,379	737,164	692,403	620,746	661,602	699,176
Brunei[7]	373,760	341,111	351,711	376,487	405,623	409,592	381,052	445,194	428,829	445,505	425,184	453,393
Poland	318,360	310,780	325,940	318,360	325,940	318,928	293,232	327,077	315,768	324,803	293,000[1]	310,000
Germany	279,727	282,155	288,926	272,665	277,551	268,028	257,967	355,683	342,387	329,688	326,842	342,000
Canada[8]	288,934	298,753	342,452	341,517	408,580	457,408	413,158	480,803	464,316	566,086	537,654	540,000
Japan[9]	214,819	205,914	210,228	214,330	211,436	218,594	214,191	214,820	207,522	216,078	216,707	218,000
Ecuador	184,780	178,122	182,053	176,252	178,776	187,525	171,138	191,746	181,331	190,542	188,712	192,360
British India[10]	182,311	173,150	181,089	197,043	210,360	196,697	132,164	197,792	187,000[1]	193,000[1]	187,000[1]	195,000
Sarawak[11]	138,031	134,311	133,684	126,439	131,901	137,497	126,578	137,281	133,248	137,824	132,240	132,007
Egypt[12]	97,818	100,699	97,203	95,082	94,509	91,927	84,974	94,545	88,535	89,935	84,998	83,412
Albania[13]	*	*	*	*	*	42,400	39,200	42,400	41,000	42,400	72,300	49,900
France	43,367	44,000[1]	42,339	42,639	42,368	43,000[1]	38,000[1]	43,589	42,839	42,000[1]	41,000[1]	42,000
Austria	13,860	17,010	18,620	20,850	19,320	25,620	28,160	30,070	29,100	32,845	30,000[1]	29,000
Hungary	*	*	*	1,930	11,980	13,744	12,451	13,976	13,000[1]	14,000[1]	13,000[1]	14,000
Czechoslovakia	10,125	9,667	10,865	12,297	11,734	11,070	10,437	12,158	10,731	10,960	10,159	10,000
Bolivia	13,509	12,271	10,736	11,751	12,810	10,302	7,128	9,100[1]	8,800[1]	9,000[1]	8,790[1]	9,500
Italy	9,064	8,694	9,233	8,565	8,493	9,048	7,969	9,612	9,459	9,563	8,646	9,400
Others[14]	6,000	5,800	6,000	5,800	6,000	6,000	5,400	6,000	5,800	6,000	5,800	6,000
Totals	180,619,698	175,555,666	179,502,940	170,137,982	172,754,846	169,666,280	151,718,717	158,539,016	162,810,287	162,133,225	158,683,150	167,726,443

[1] Estimate. [2] Russian Sakhalin included with Russia.
[3] Anglo-Iranian Oil Company Ltd figures revised—fuel oil returned to ground has been deducted.
[4] International Petroleum Company and Lobitos Oilfields Ltd. figures combined.
† Estimated by competent private sources in Mexico.
‡ Estimate based on information supplied by the C.T.M. (labor syndicate).
* Details not available.
[5] Does not include Assam and Punjab, which are listed separately under British India.
[6] Bahrein Petroleum Company Ltd. figures.
[7] British Malayan Petroleum Company Ltd. figures.
[8] Includes natural gasoline production.
[9] Japanese Sakhalin, Taiwan (Formosa) and Hokkaido included with Japan.
[10] Excluding Burma.
[11] Sarawak Oilfields Ltd. figures.
[12] Anglo-Egyptian Oilfields Ltd. figures.
[13] Italian imports of Albanian oil.

Official Crude Oil Production Figures for 1932 to 1937 (Revised)

	Daily Average to July 31 1938 (Bbl.)	Daily Average 1937 (Bbl.)	Total to July 31 1938 (Bbl.)	Total 1937 (Bbl.)	Total 1936 (Bbl.)	Total 1935 (Bbl.)	Total 1934 (Bbl.)	Total 1933 (Bbl.)	Total 1932 (Bbl.)
United States	3,329,458	3,500,418	705,845,000	1,277,653,000	1,098,516,000	996,596,000	908,065,000	905,656,000	785,139,000
Russia	563,170	553,305	119,392,000	201,856,661	199,635,921	184,008,033	175,635,783	155,596,429	155,927,997
Venezuela*	501,256	514,182	106,266,189	187,675,477	155,270,840	148,809,057	136,098,681	117,113,940	115,615,782
Iran*	228,513	213,997	48,444,885	78,109,001	62,977,950	57,520,488	57,902,092	54,440,075	49,516,697
Netherland India	149,186	148,255	31,627,429	54,112,933	47,961,744	45,307,913	45,107,828	41,234,498	37,988,913
Roumania	134,088	142,948	28,426,692	52,176,000	63,532,846	61,270,072	61,849,306	53,919,708	53,651,978
Mexico	71,976	127,275	15,258,977	46,455,687	41,027,915	40,240,563	38,171,946	34,000,830	32,805,496
Iraq	85,659	83,846	18,159,810	30,603,660	29,913,150	27,410,983	7,639,849	1,094,915	871,840
Colombia	57,401	55,609	12,168,994	20,297,543	18,756,110	17,397,655	17,337,900	13,156,126	16,415,214
Peru*	44,613	47,827	9,458,024	17,457,024	17,593,059	17,066,555	16,314,381	13,257,318	9,899,432
Argentina*	44,684	44,807	9,473,000	16,354,717	15,457,960	14,297,025	14,021,901	13,690,556	13,138,747
Trinidad*	46,995	42,473	9,953,033	15,502,989	13,237,030	11,671,224	10,894,363	9,561,353	10,126,121
Burma	20,323	21,279	4,308,472	7,766,487	7,587,718	7,181,113	7,278,859	7,114,311	7,073,437
Bahrein*	23,228	21,266	4,924,270	7,762,264	4,644,635	1,264,807	285,078	31,377	902
Brunei*	14,098	12,047	2,988,749	4,397,038	3,355,086	3,359,054	2,741,341	2,070,162	1,220,426
Poland*	10,296	10,416	2,182,808	3,799,862	3,869,575	3,901,881	4,011,336	4,174,079	4,219,634
Germany	10,484	8,625	2,222,595	3,148,300	3,076,858	2,967,438	2,204,402	1,656,602	1,594,807
Canada*	11,601	8,026	3,459,425	2,995,025	1,507,931	1,447,204	1,410,895	1,145,333	1,044,412
Japan	7,013	6,817	1,505,912	2,487,841	2,403,072	2,294,878	1,872,837	1,504,412	1,683,439
Ecuador*	6,148	5,922	1,303,354	2,161,436	1,942,467	1,731,785	1,636,619	1,619,902	1,597,641
British India	6,078	5,864	1,288,653	2,141,158	1,978,329	2,037,810	1,921,863	1,628,803	1,743,878
Sarawak*	4,418	4,535	936,675	1,655,565	1,574,196	1,806,795	1,975,617	2,244,331	2,369,338
Egypt*	2,917	3,187	618,346	1,163,267	1,262,666	1,253,151	1,527,252	1,653,535	1,071,976
Albania	1,555	386	329,600	536,000	308,200	29,000	17,500	11,437	9,212
France	1,379	1,387	292,428	507,067	534,063	529,664	700,000	786,366	755,146
Austria*‡	966	606	204,795	221,266	50,092	44,347	27,965	5,765	804
Hungary	444	38	94,171	13,910	Nil	Nil	Nil	Nil	Nil
Czechoslovakia*	356	339	75,515	122,790	126,603	136,580	177,797	121,695	126,603
Bolivia*	296	337	62,620	123,123	104,746	163,295	157,875	111,973	41,907
Italy	300	315	63,697	114,801	129,653	128,615	162,449	213,534	242,563
Other countries	193	192	41,000	70,000	37,100	32,300	64,000	54,100	73,300
Total	5,379,092	5,586,526	1,141,377,118	2,039,442,576	1,798,363,515	1,652,107,285	1,517,212,709	1,438,870,468	1,305,585,642

*Revised by official sources.
‡Conversion factor revised.
January-June, 1937 total, 993,624,368 bbl.

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Petroleum Industry. Edited by Dr. O. W. Willcox

GEOPHYSICS

Continuous Electrical Profiling—J. J. Jakosky, in GEOPHYSICS, vol. 3 (1938) No. 2, pp. 130-153.

This paper describes certain improvements that have been made in applying electrical methods to deep structural work. It is a "method of continuous profiling," based on measurement of earth conductivity between a fixed electrode and a traveling electrode, the above-ground connection being made through an insulated wire.

An outfit for such profiling consists mainly of a truck which has special wheels with metal fins which cut into the ground to a depth of about 8 inches. As the truck travels along it unreels the wire attached to the stationary electrode and a continuous record of the current passed is obtained. The necessary current is supplied by a generator on the truck. One such run may cover 5,000 to 20,000 feet. Up to December, 1937, about 10,000,000 acres in various parts of the United States have been surveyed by this method.

The object, of course, is to define subsurface structures. Experience indicates that, in general, the resolving power as regards definiteness of data obtainable under average conditions the method lies somewhere between the reflection seismic method and the gravitational and magnetic methods, and in cost approaches the latter. An important field for continuous electrical profiling is in rapid reconnaisance work.

DRILLING

Well-Depth Measurements—C. E. Reistle Jr., and S. I. Sikes Jr., before AMERICAN PETROLEUM INSTITUTE, Wichita Meeting, May, 1938.

The importance of well-depth measurements has always been recognized, and has been particularly emphasized by the difficulties in successfully completing oil wells where relatively thin oil producing sections are encountered in intimate contact with gas or water sands.

These difficulties have become more evident at the increasingly greater depths which drillers for oil are now reaching.

The practices observed in measuring well depths vary between different sections of the country, between the various companies, and even between districts in a given company. To obtain a general idea of these procedures a questionaire was sent out, and numerous replies were received. This material was digested and put into the form of a preliminary report to the committee on drilling practice of the A.P.I. The final conclusions are embodied in the present paper.

The outstanding conclusion is that drill pipe offers the most desirable means of measuring depths of wells drilled by rotary tools. In drilling with cable tools the first requirement is an accurate determination of the "distance over," i.e. the length of wire from the sand-reel flanges over the crown block to the surface of the derrick floor.

It is emphasized that well-depths cannot be measured by any procedure wherein all errors may be determined and corrected. This means that sources of error should be recognized and every effort made to reduce their influence to a minimum. Among these sources of error the following are enumerated:

Mistakes of the crew making the measurements. Here proper instruction and supervision are called for. When accurate depth measurement is necessary two independent measurements, preferably by different crews, should be made.

Inaccuracies in measuring standing pipe without allowing for sag; this may be eliminated by measuring pipe lying on the rack.

Reading pipe measurements to the nearest whole inch. Here is a large chance for human mistakes.

Stretch due to pull on the tape. To eliminate this error a standard pull should be used.

Permanent deformation of drill pipe; lengths should not be stenciled on, as drill pipe in service tends to stretch.

Failure to calibrate cables; this should be done frequently, especially on new cables.

To eliminate errors introduced by forces due to acceleration cables should not be pulled out of the hole faster than one foot a second.

In general, most purposes of well-depth measurements will be served by relative as well as by absolute figures. For this reason no particular attention need be paid to elongation due to stretch of pipe under its own weight, or to elongation due to thermal expansion.

The paper contains much information and many useful hints which should be carefully studied.

Determining Water Content of Cores—M. D. Taylor, in OIL AND GAS JOURNAL, vol. 37 (1938), No. 5, pp. 59-60.

The importance of a knowledge of the water content of cores is generally recognized and numerous methods are available for this determination. Some of these methods are subject to error on account of the presence of water of hydration, which should be taken into account in estimating real porosity.

The method here proposed depends on the fact that the temperature at which kerosene and alcohol will form a homogeneous mixture is greatly dependent on the amount of water present. Hence, by treating the core with a solution of alcohol in kerosene and noting the temperature at which separation occurs a measure of the free water content, distinct from the water of hydration can be obtained. The method described by the author has been found to be rapid and convenient and the results consistent with information obtained from other sources.

OPERATION

Production of Crude Oil by Mining Operation in Roumania—V. Velehorsky, in MONITEUR PETROLE ROUMAIN, vol. 39 (1938) No. 9, pp. 671-680.

Crude oil has been produced by mining operations at Sarata-Monteoru since 1844, mostly by peasants of the locality, who have sunk shafts reaching in some cases to depths of nearly 700 feet. From the bottom of these shafts, which are carried below the oil sands, galleries are driven into the sand to provide drainage. The oil won is pumped to the surface; it is heavy and contains little gasoline. The peak of production, about 15,800 tons, was reached in 1933; about 70 men are now employed by the Steaua Romain, which has taken over the field. The returns barely meet expenses, but might become of importance with an improvement in the markets.

Conservation of Gravity in the Production of Oil—S. F. Mauney, Jr. and George M. Vandaveer, Jr. before AMERICAN PETROLEUM INSTITUTE, Wichita meeting, May, 1938.

Conservation of gravity in the production and handling of oil not only effects a saving of volatile portions, but also of volume, inasmuch as any loss in gravity of crude oil means a decrease in volume. It is, therefore, a true form of conservation. Much attention and publicity have been given to conservation of crude oil from the standpoint of supply and demand, application of more effective production methods, and the use of secondary recovery methods; whereas conservation as related to gravity has, as a general thing, been sadly neglected. Many phases of this loss have been unrecognized; and other phases, although recognized, have been considered necessary evils. The losses that occur in producing, treating, storing, and transporting crudes are insidious in that they are not visual, and usually there is no readily-apparent nor convenient method of determining the losses. This is particularly true of losses occurring in production and in lease treating and storage.

Spoken of in terms of percentage, the losses appear small, but when stated in dollars they assume enormous proportions. It has been estimated that losses from well to refinery have been cut from 6.2 percent in 1921 to approximately two percent in 1934. The authors believe that this figure is entirely too small for 1934, and even for 1938; because on many leases, by attention to treating and storage, it has been possible to save more than two percent

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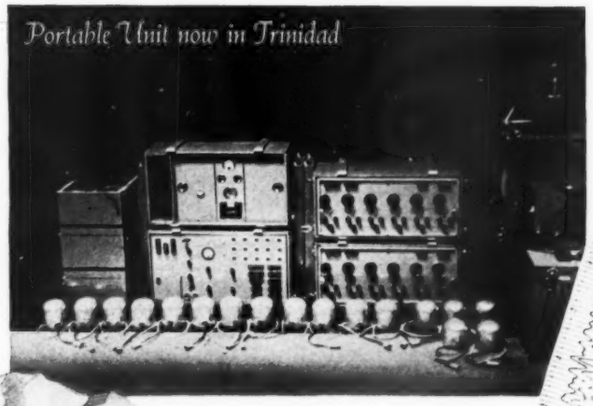

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by volume. However, applying two percent to the daily Mid-Continent production of 1,910,000 bbl., the loss amounts to 40,000 bbl., which at $1.22 (36 deg. A. P. I. gravity oil) amounts to $48,800. More than 50 percent of the losses occur on leases where gravity affects price; and the estimated evaporation loss indicates approximately an 0.4-deg. loss in gravity, which means that probably one-third of the production is changed to a lower-gravity bracket—thereby losing two cents a barrel in price. This amounts to a further daily loss to Mid-Continent producers of $6,400 which, added to the value of the volume loss, makes a total daily estimated loss of $55,200. This estimated value does not represent the true loss, as the portion evaporated is gasoline—which is more valuable than the average price for crude indicates.

The conservation measures that can and should be used are outlined.

Bottom-Hole Pressures in Current Oil-Well Operations—C. V. Millikan, before AMERICAN PETROLEUM INSTITUTE, Wichita meeting, May, 1938.

Pressure and fluid levels have always been used in the operation of oil wells. Only the measurement of effective (bottom-hole) pressures is new. Most bottom-hole pressure work has been directed to operations of the field as a whole, but in the future more work will be directed to the operation of individual wells and leases. All oil produced is the result of pressure difference between the producing formation and the bottom of the hole. These pressures are basic, and any operating procedure depends on these pressures for its accomplishment. Bottom-hole pressure determinations can be an important aid in determining the reservoir condition, ability of the well to produce and, if the hole is in condition, for the well to produce to the best advantage. They can also be used to determine the condition of the screen or liner. Bottom-hole pressure measurements can aid in the solving of pumping-well problems by giving, in addition to the information mentioned above, data which will prove whether the amount of fluid which is being produced is limited by the ability of the well to produce or the ability of the equipment to lift the available fluid. In fact, every condition in the reservoir, in the hole, or in the equipment which affects rate of production will affect the bottom-hole pressure.

Elements of Waste-Water Separator Design: Report of an Investigation Using a Model Separator—W. B. Hart, before AMERICAN PETROLEUM INSTITUTE, Wichita Meeting, May, 1938.

The problem of removing oil from waste waters is one of long standing. In 1927 a survey to determine the extent of oil pollution was conducted by the American Petroleum Institute. In 1928, as a result of the survey, a Technical Committee for Prevention of Pollution was authorized and organized by the Institute. One of the first problems scheduled for investigation by this committee was a separator design. Work on the solution of this problem was started in 1929.

The separator design that evolved from these investigations in 1931 was a pioneer product that was effective in many respects, but it had limitations. Increasingly drastic attitudes of local authorities in pollution prevention has made it necessary to produce an efficient separator, and the executive committee of the A. P. I. started work on a new design at the Philadelphia refinery of the Atlantic Refining Co. A model plant was put in operation in November, 1937.

The author outlines the principles of this model plant, and states that while no large scale separators have been built, there is every reason to believe that such separators, when constructed according to the design data here given, will discharge an effluent that will be satisfactory in any locality.

NATURAL GAS

Recent Improvements in Natural Gasoline Manufacture—H. H. Beeson in OIL and GAS JOURNAL, vol. 37 (1938), No. 1, pp. 97-99-101.

Manufacture of natural gasoline in East Texas affords an interesting study because the gas of this field is not only rich in gasoline but also contains large quantities of butane and propane. The author describes the system used at the Sabine Valley gasoline plant, which operates by the latest forms of the vapor rectification process (Petroleum Engineering. Inc. patents.)

The vapor rectification type of plant is especially applicable to the type of gas in the East Texas field due to the large percentages of ethane, propane and butanes. When additions are made to the Sabine Valley plant for the recovery of high percentage of propane, it will be necessary to condense ethane for reflux. This will require compressing the overhead vapors from the recovery column to approximately 700 pounds pressure before passing through the reflux condensers. The reflux obtained will be expanded into the top of the column.

The advantage of this type over the absorption type is the installation cost and the ease and economy of operation. The process in itself is quite simple and requires a minimum of attention from the operator. The cost is low due to the low water circulation and the low quantity of steam required. It is also an advantage to have high-pressure residue gas available for the field where a saving is obtained in the smaller residue pipelines required.

Acid Treatment of Gas Wells to Increase Production—M. E. Chapman before AMERICAN GAS ASSOCIATION, New Orleans meeting, May, 1938.

The use of acid to increase production of oil and gas wells has become a well established practice throughout the oil and gas industry. The acidizing of calcareous formations to stimulate natural gas recovery has not become nearly so wide spread as the acidizing of oil wells. Acid treating of gas wells has been largely confined to portions of Kentucky, North Louisiana, the Panhandle of Texas and the Hugoton gas area of Kansas.

During the early days of acid treating of gas wells it was the usual procedure to use compressors. Briefly, the method used was to introduce acid into the well at the casinghead and then the acid solution was driven into the producing formation by the use of compressed air or gas. Usually considerable time was required to treat a well in this manner. The latest innovation in the treating of gas wells is to use water behind the acid as a pressure medium. Only sufficient water is placed behind the acid to balance the bottom hole pressure and thereby drive the acid into the producing formation.

During treating, three or four pumping units are used. Connections are arranged so that all the pumping units will simultaneously deliver the treating solution and subsequently the water load. When wells are treated by this method a bailing or swabbing unit is stationed at the well. The bailer or swab is run following the treatment and sufficient water is taken from the top of the water column to unbalance the bottom hole pressure. Usually one pull with the swab is sufficient. The wells are then allowed to flow into the air and clear themselves of the remainder of the water and the spent treating solution.

The rapidity of these operations is the principal factor in the success of the new method. For instance, a well in the Texas Panhandle was treated in 23 minutes, using 5000 gals. of acid followed by a water load of 53 bbls.; 20 minutes was allowed for the chemical action.

Gas Purification by the I. G. Alkacid Process and Sulphur Recovery by the I. G. Claus Process—Hans Baehr, before AMERICAN PETROLEUM INSTITUTE, Wichita meeting, May, 1938.

The use of alkaline inorganic scrubbing agents, such as sodium- or potassium-carbonate solutions, for the absorption of weak acids such as carbon dioxide or hydrogen sulphide from gases, has not been found economical due to the low absorptive capacity of these solutions for hydrogen sulphide and carbon dioxide. The absorption of these gases was improved by the use of aqueous solutions of tripotassium phosphate and the slightly-volatile organic bases of the alkylolamine group such as mono-, di-, and triethanolamine used in the Girdler process.

In the Alkacid process, strong inorganic bases with weak organic non-volatile acids, such as aminosulfoacids and aminocarbonicacids, are used as the absorption agents. Three solutions were developed and introduced in the market under the names Alkacid solution "M," Alkacid solution "Dik," and Alkacid solution "S"—each of which has a specific field of application. Alkacid solution "M" is used for the removal of hydrogen sulphide or carbon dioxide, either separately or simultaneously. Alkacid solution "Dik" is used for the selective removal of hydrogen sulphide from gases containing carbon dioxide, and Alkacid solution "S" is used for removing hydrogen sulphide and carbon dioxide from gases containing impurities such as tar, dust, and certain other gas constituents. A much shorter time of contact is required for the saturation of these Alkacid solutions than for the other solutions mentioned.

The selectivity of the Alkacid solutions depends not only on the chemical composition, but also on the physical conditions employed, such as the time of contact, the temperature, etc. The absorption takes place at a low temperature, while the reactivation is carried out at 105 deg. C.

TRANSPORTATION

Developments in Oxyacetylene Welding of Pipe Lines—F. C. Hutchinson, before AMERICAN GAS ASSOCIATION, New Orleans Meeting, May, 1938.

During the past year, two developments of far-reaching importance have resulted not only in speeding the oxyacetylene welding of overland pipe lines, but also in producing higher quality welds at low cost. These are: (1) new four-flame tips for bell-hole or position welding, and six-flame tips for rotating welds, and (2) a new low-alloy steel welding rod. In addition, a new procedure, known as the one-third roll method of pipeline construction, has proved to have a number of advantages under certain conditions over methods formerly used.

The author describes the new welding tips and rod, and gives some results.

In October and November, 1937, a southwestern natural gas company operating hundreds of miles

of high-pressure gas lines installed a high-pressure, 16-inch line using the new four-flame tips and high-strength welding rod. The results obtained on this line should prove interesting as an indication of the greater speeds possible with the new rod and tips.

The line was 20 miles in length and was completed in 27 working days. The all-bell-hole method was used on the first half of the line and the one-third roll method on the latter half. Although there was no appreciable difference in speeds and costs between the two methods, the one-third roll method appeared to give a better quality of workmanship. It has since been adopted by this company as the standard method of pipe line construction, and has been used successfully on recently completed 6-, 8-, and 12-inch lines.

On the 16-inch pipe with ¼-inch wall thickness, operators easily averaged 33 welds per nine-hour day, with individual daily production as high as 45 welds in nine hours. An average of 21 cubic feet of oxygen, 21 cubic feet of acetylene, and 1 pound of rod was used for each weld.

Since its completion, this line has been in service carrying gas pressures in excess of 500 pounds per square inch. It has already gone through the coldest part of the year carrying peak loads without developing any trouble.

Oil Pipe Lines in Roumania—Ion Midescu, in MONITEUR PETROLE ROUMAIN, vol. 39 (1938), No. 11, p. 883.

The matter of pipelines from the oil fields of Roumania to the ports of shipments is an illuminating example of the conflict between two sections of the same national economy. On the one hand is the pressure of the petroleum interests for the construction of adequate and cheap pipe line facilities to reach the export outlets, and the resistance of the railroad interests (dominated by the government) that would lose greatly by loss of the oil traffic.

There are now four main pipelines in Roumania, as follows: Campina-Constantza (10 inch), 2600 tons per day; Baicoi-Giurgiu (5 inch), 500 tons; Ploiesti-Giurgiu (5 inch), 500 tons; Baicoi-Bucarest (5 inch), 700 tons a day. These lines carry only about 11.4 percent of the 4,441,618 tons annually exported from the country. These conduits were installed shortly after the war, when the industry was relatively small. Since they have proven that they can carry oil at around a fourth of the cost to ship by rail, the oil industry has long clamored for the right to build, at its own expense, sufficient pipeline capacity to carry the whole export trade. But the government figures that the loss to the railroads is too heavy a price to pay for the convenience of the oil men; apparently the intention is to favor the railroad employees so long as the price obtained for Roumanian oil on the world market is just enough to keep the oil industry going.

Note.—This situation is a pat example of many features of the "planned economics" that are becoming more and more prevalent in many European countries.—Ed.

USES

Ageing of Diesel Engine Lubricating Oil During Use—R. Heinze and E. Widdecke, in OEL AND KOHLE, vol. 14 (1938) No. 20, pp. 415-419.

The authors made a study of six high-quality lubricating oils for Diesel engines, including engines used on streamlined super-express trains.

The chief result of this investigation is a new criterion of Diesel engine lubricating oils: the "volatility number," which is determined as follows: 200 grams of the oil are placed in a still, *a*, immersed in a tin-lead bath, *b*, kept at 320 deg. C. Superheated steam from *c* is passed through the still; the mixture of oil and water vapor is condensed in *c* and collects in the measuring cylinder *f*. The time of distillation is 100 minutes. From time to time during the distillation the ratio of volume of oil distillate to water distillate is noted, and so a distillation curve may be plotted. The test is discontinued when the ratio of oil to water is 1:10. The "volatility number" is found from the expression: $\frac{\text{Increase of oil}}{\text{Increase of oil} + \text{water}}$.

During the distillation a slight vacuum, equivalent to 10 inches of a water column, is maintained in the apparatus.

From the results tabulated in the table below it appears that there is a striking correlation between viscosity index (V. I.) the "volatility number" ("V. N.") and its converse, the non-volatile residue.

Oil	"V.N."	Non-Vol. Residue	V.I.	Conradson no.
A	61	52,5	1,83	0,77
B	90	40	1,88	0,72
C	69	33	2,45	0,82
D	130	16	2,58	0,44
E	132	13	2,73	0,56
F	163	9,5	2,97	0,13

This correlation is taken to indicate that conclusions can be drawn from the volatility number as to the behavior of a lubricating oil in the combustion chamber without reference to viscosity or specific gravity.

However, it is noted that all these oils were of proven good quality, in spite of notable differences in viscosity index, gravity, apparent molecular weight and Conradson number, which indicates that "goodness" of an oil does not strictly depend on one or even several physical characteristics.

Aside from setting up this new criterion the authors deduce from their experiments a rule that a Diesel engine lubricating oil should be changed when the amount of foreign substances, principally colloidal carbon, has increased to 1.0 or 1.5 percent.

Cutting Oils—E. W. Hallam, in TIDE WATER WORLD, vol. 7, (1938) No. 2, pp. 6-9.

Cutting oils, which are used in machining metal products have to meet certain stringent requirements. In the first place a good cutting oil must have the quality of an extreme-pressure lubricant to protect the tool and stand up under the great forces involved, and it must have a good cooling effect. It must be oily and not tacky. It must not corrode or tarnish the metal, even copper. It must be relatively transparent so that the operator can view the work while in operation. It should be sterile, non-toxic, and non-irritating, and its odor should be harmless; this is important, as skin infection is a very serious trouble to start in a large manufacturing plant. And there should be no separation in the oil, either in storage or in use; no rancidity should develop, and the cutting oil should readily blend with low viscosity mineral oils, without heat, to secure any desired cutting properties within the range of each oil developed.

To meet these requirements, especially that of being an extreme pressure lubricant, it is necessary that sulphur be permanently incorporated in forms that will not separate. The development of such an oil has been difficult, but within the past two years transparent, non-tarnishing sulphurized cutting oils have come on the market and appear capable of taking care of any requirement up to broaching.

SUBSTITUTES

Portable Gas Filling Stations in Germany—P. Zotta, in PETROLEUM, vol. 34 (1938), supplement to No. 12/13, p. 3.

Compressed city gas is finding increased use as a motor fuel in Germany, due to the high price of gasoline. Several years' experience on a fairly wide scale have shown that automobiles and trucks can be fitted with steel sylinders capable of holding enough gas under pressure for service trips of 75 to 100 mi. under full load. The government has looked kindly on this development because it means an important contribution to the nation's supply of automotive fuel, and a valuable supplement to the scanty domestic supply of petroleum. It also means less dependence on the expensive processes of making synthetic gasoline from coal and water gas.

However, the use of compressed city gas for automotive purposes has been confronted by the difficulty of providing filling stations at convenient points. The compressed gas is readily available at the gas works, but more widely distributed filling stations are needed if this use of gas fuel is to become general. The laying of pipelines for distributing high pressure gas in as eventual possibility. In order to meet current demands a portable gas filling station has been invented and put to use with the approval of the authorities. Such stations consist of a truck that carries 12 cylinders of special lightweight but strong steel capable of holding a total of 1,680 cu. m. (about 60,000 cu. ft.) of gas under a pressure of about 350 atmos. (about 5,250 lb.). When filled at the gas works the truck is driven to its station and the gas, after suitable pressure reduction, is metered to customers whose vehicles are provided with gas drums instead of gasoline tanks. One truck load will provide 18 to 20 average fillings, after which it is returned for a new charge. The outfit is foolproof and simple in operation.

Storage Stability of Alcohol Containing Motor Fuels—K. R. Dietrich and W. Lohrengel, in OEL AND KOHLE, vol. 14, (1938) No. 20, pp. 419-422.

After 12 months storage no alteration of color and no deposition of sediment was to be observed in absolute alcohol or motor fuels prepared therefrom by mixing with gasoline.

The substances under test were kept in sheet iron drums communicating with the outer air through a pipe containing silica gel to absorb atmospheric humidity.

Production of Fischer-Tropsch Coal Spirit and its Improvement by Cracking—C. S. Snodgrass and M. Perrin, in JOURNAL INSTITUTION OF PETROLEUM TECHNOLOGISTS, vol. 24, (1938) No. 175, pp. 289-301.

The conversion of a mixture of hydrogen and carbon monoxide (water gas from coke) into liquid hydrocarbons is now a well accomplished fact, but so far as the consumer is concerned this is by no means the final stage, because the hydrocarbons obtained in the Fischer-Tropsch process require further important processing to convert them into high-quality automobile gasoline.

The outstanding feature of the Fisher-Tropsch process is a small direct production of usable gasoline and a large production of very low octane naphtha and paraffin wax; the amount of this wax may amount to 30 or 40 percent of the initial synthetic

product. In so far as the market will not absorb this wax it is necessary to crack it for the production of gasoline. This has proved a difficult problem because the Fischer-Tropsch oil and wax are highly refractory in the sense that there is little "cracking per pass" so that the oil has to be recirculated many times through the cracking plant before cracking is completed.

In view of this refractoriness of the charging material there are two alternatives: either to build a large and expensive cracking plant for a low rate of conversion or resort to severe cracking in a smaller plant, which would involve coking difficulties. After exhaustive study it was found that cracking in the true vapor phase would solve the problem, and the two plants that operate the Fischer-Tropsch synthesis are now working on that principle.

The essential feature of true vapor phase cracking as operated in these plants is that the refractory oil is vaporized, and while in the vapor phase is mixed in a reaction chamber with inert "cycle gas" (N_2, CO_2, CO,H_2, CH_4) that has previously been heated to a high temperature. This hot cycle gas instantly raises the temperature of the oil vapors to the cracking point. This admits of very exact temperature control, and also of the time of reaction, so that the point of optimum yield can be established and maintained; the hot hydrocarbons can be quenched and removed from the cracking zone at the desired moment.

At that, the plant at Holten (Germany) produces a gasoline of only 63 to 64 octane number which has to be blended with benzol to produce a gasoline of 70 octane. Higher octane numbers could be produced at a sacrifice of yield.

A feature of outstanding importance in all true vapor-phase cracking is the absence of coke formation. This is due to the fact that the cracking reaction takes place in a large reaction chamber and not in the narrow tubes of the heating coils.

Gasoline from Waste Rubber—Isunetaro Kato, in JOURNAL SOCIETY CHEMICAL INDUSTRY OF JAPAN, vol. 41 (1938) No. 3 (supplemental binding), pp. 83B-85B.

Experiments show that when waste rubber is cracked in the presence of heavy petroleum oil a gasoline is obtained that has an octane number of around 72 (CFR motor method) which with 0.1 percent ethyl lead is raised to 85 and 89 and is thus suitable as an aviation fuel. The best working pressure is 180 atmospheres.

Gas as Motor Fuel—Arthur D. Little, Inc., INDUSTRIAL BULLETIN, February, 1938.

In a country so rich in oil resources as the United States it would seem that the question of gasoline substitutes is a subject to be considered only when the end of petroleum reserves is really in sight. The matter is different in certain foreign countries, where there has been extensive research in this direction and where increased attention is being paid to the use of compressed gas as a gasoline substitute.

The use of gas as such as a motor fuel started during the War, with the provision of large low-pressure collapsible fabric gas bags on the tops of French busses. Developments in metallurgy have since made possible the use of light-weight cylinders to carry compressed gas at 3000 pounds pressure. Those developed in England by the Chesterfield Tube Company for the City of Birmingham Gas Department are eight inches in diameter outside, six feet long, weigh 110 pounds, and carry 350 cubic feet of gas each. Six of these, strapped to the underside of the chassis of a truck or bus, carry a gasoline equivalent of six to fifteen gallons, depending on the quality of the gas compressed. City-gas at 25 cents per 1000 cubic feet is equivalent to gasoline at 9 cents per gallon after allowance for the cost of compression to 5000 pounds and for fixed charges on compressor equipment; natural gas at 25 cents per 1000 cubic feet is equivalent to gasoline at 4.5 cents per gallon on the same basis. With the present tax on gasoline and none on gas, it appears that a gas company could make money and a transport company in the same city could save money by the use of compressed gas.

British experience over a period of several years with hundreds of busses has been very favorable. Gas is claimed to be the perfect motor fuel from the standpoint of ease of starting, freedom from vapor-lock, smooth and economical idling, good acceleration, freedom from gum troubles and carbon deposition, absence of crank-case dilution, and low carbon monoxide content of the exhaust.

Note.—The petroleum industry has been charged with much of the ruin into which the coal industry is falling. On the other hand, the coal industry has been charged with failure to carry out research that might enable it to defend itself. Instead of relying on political pressure to curb competition from oil the coal interests might do well to make a thorough study of the possibilities of coal gas as a competitive motor fuel, especially for long distance bus traffic and trucking. With prices and taxes what they are, the conversion of coal into gas at the mines and its transport by pipeline may be economically feasible. —Editor.

ASPHALT & TAR

Bituminous Emulsion Treatment of Permeable Sub-soils—Anon; PETROLEUM TIMES, May 21, 1938, pp. 649-651.

A bituminous emulsion (Shell-perm) has been used with success in sealing permeable sands against intrusion of water, which under certain circumstances may be especially desirable in engineering work, as when excavating foundations for dam sites, etc. The *modus operandi* is to sink a pipe into the sand and pump the emulsion under pressure. The composition of the emulsion is such that after a shorter or longer time coagulation takes place, filling the pore spaces of the sand with bitumen particles that obstruct the passage of water. In this way vertical or horizontal screens may be formed in the soil as desired. The method was given an extensive tryout at the Assiut barrage on the river Nile with results that are described as very satisfactory.

Influence of Paraffin on the Characteristics of Bitumens—Vasile Th. Cherches, in MONITEUR PETROLE ROUMAIN, vol. 39 (1938) No. 11, pp. 889-895.

The author has made an extensive survey of the literature relating to the effect of paraffin on the properties of asphalts and tars as engineering materials.

Opinion on the subject is divided. On the one hand are writers who affirm that paraffinous asphalts, tars and bitumens are unsuitable for paving work because paraffin diminishes ductility and adhesion. On the other hand there are writers who maintain that a moderate amount of paraffin has no adverse affect on the general properties of bitumens. Work done in the petroleum laboratory at the Polytechnic Institute of Lvov (Poland) is cited to show that bitumens with 10 percent of paraffin are no less suitable for road construction than the most celebrated American products, and at that, the upper limit of paraffin content has not been ascertained. Some authorities consider paraffin a good plastifying agent, and others affirm that there is little danger of paraffin separation because of the colloid protective action of soft asphalts. Where bitumens show small ductility this is likely to be due to the presence of asphaltenes, and in any case is more likely to be due to ceresins than to paraffin. Then again the soft paraffins must have a smaller influence than the hard paraffins. Hence, if there is a "paraffin" question in asphaltology, attention should be paid to the form and nature of the paraffin as well as to its quantity.

GENERAL

The Day-Degree—A. Minne in REVUE DES COMBUSTIBLES LIQUIDES, vol. 16 (1938), No. 154, pp. 125-129.

The "day-degree" has been proposed as a measure of the difference between the average daily temperature and a standard normal temperature. Thus, suppose that the assumed normal temperature is 65 deg. F. and that on a certain cold winter day the average temperature for that day is 15 deg. F.; then the average temperature for the day in day-degrees is —50.

The author relates this concept to the domestic fuel oil business as follows: The manufacturer of a heating equipment assures prospective customers that his outfit will accomplish certain results and economies. In view of the fact that the amount of heat required during a winter varies from day to day and from season to season the user has no standard by which to estimate the degree of fulment of the promises. On the other hand, the seller has nothing very definite to go on when the client requires him to furnish a guarantee that his heating equipment will maintain a standard house temperature with a minimum expense of fuel oil or coal.

Here is where the day-degree idea will point the way. The sellers of fuel oil and oil burners should subject their products to tests that will show the exact correspondence between inside and outside temperatures in relation to fuel consumption, expressed in day-degrees. Contracts could be written on that basis (with due regard to the type of structure) and the customer, by referring to a record of day-degrees in his locality, could satisfy himself that the contract terms have been met.

FRONT COVER

THIS month the front cover shows Continental Oil Company's Tepetate field at night. The compressors that return the gas to the well are housed in the small building in the left background, just behind and to the right of the rectangular cooling tower. The small black and silver upright tanks at the extreme right are high pressure field separators, one to a lease, which receive and measure the oil and gas direct from the wells. In front of them are the gasoline rundown tanks. Dimly perceptible in the left center background are the lights on a distant derrick. The 80,000 barrel field storage tank is out of the camera's range.

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OIL AND GAS WELL CHEMICAL SERVICE

U. S. S. R.

Soviet Oil Operation Figures

1938	Production bbl.	Daily Average bbl.	Run to Stills bbl.	Drilling feet
January	17,647,000	569,258	15,882,000	320,000
February	13,591,000	485,393	13,122,000	320,000
March	15,984,000	515,613	14,842,000	340,000
April	17,850,000	595,000	15,850,000	400,000
May	17,580,000	567,097	15,600,000	420,000
June	18,540,000	618,000	15,900,000	550,000
July	18,200,000	587,097	16,800,000	500,000
Total 7 Mos. 1938	119,392,000	563,170	108,796,000	3,150,000
Total 7 Mos. 1937	116,887,400	551,356	107,890,000	3,635,600
Total 1937	202,856,661	555,772	187,121,389	6,244,660
Total 1936	199,634,921	545,450	180,582,274	6,958,916
Quota 1938	244,215,000*	666,066	215,055,000	not available
Quota 1937	234,450,000	642,329	208,285,000	9,240,000
Quota 1936	222,345,000	607,000	182,250,000	7,100,000

*Crude oil and gas

PROFITABLE production of gold on an extensive scale and valued at the current high prices resulting from the Roosevelt devaluation policy has completely changed the Soviet petroleum problem and has placed the U.S.S.R. in a far more favorable position as regards internal affairs. No longer is it essential to Russia to export petroleum products at a sacrifice irrespective of domestic requirements. Her petroleum export position in consequence has completely changed during the past few years. In 1932 Soviet oil exports aggregated 6,106,000 tons, including 3,018,000 tons of gasoline, as compared with 1,930,000 tons and 350,000 tons, respectively, in 1937, and 332,280 tons and 117,847 tons for January-June, 1938.

During the last year 181,675 tons of gasoline were shipped from California to Russia for blending, compared with 64,280 tons in 1936, or equivalent to one-third of Soviet gasoline exports for the same period. This was rendered necessary by the fact that much of the Soviet refinery output on the Pacific coast could not meet the requirements of Far Eastern military operations.

During the second Piatiletka there was a change in state policy in Russia. Attention was turned from agriculture and light industries to the heavy basic industries, to aviation, to motor transport, and to national defense measures; all of which are dependent upon an adequtae supply of petroleum products. The demand for military and civil aviation grew rapidly, while the output of commercial and military motor vehicles increased to about 230,000 units in 1936.

At the end of 1937 the demands by Soviet agriculture also increased, regardless of the fact that the greatest concentration of efforts was along other lines of endeavor as just stated. No fewer than 453,000 tractors, 133,000 combines, and 120,000 trucks were in operation on the farms. A considerable number of the tractors and heavy trucks are powered with Diesel engines turned out at the tractor plants at Kharkov, Tcheliabinsk and Moscow, which lowered some of the pressure on internal gasoline requirements. Nevertheless, the consumption of motor fuel for all automotive units was practically put on a ration basis during part of 1937 partly owing to the comparatively low efficiency of the refining division of the country's petroleum industry, and partly because of the production of crude having been under the quota.

As may be gathered from the foregoing analysis on this page, while crude production has steadily increased every year from about 6,500,000 tons in 1924 to 31,500,000 tons in 1937, it has not been possible to maintain exports and simultaneously meet the domestic consumption demands of gasoline. One had to suffer, so exports were reduced as being the lesser of two evils, the Soviets no longer having the need of outside gold to establish credits for equipment and machinery purchases in other countries.

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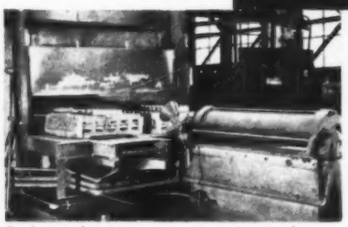
LIFE BEGINS for pump liners

IN AXELSON'S FOUNDRY CONTINUES FOR MANY YEARS IN PRODUCING WELLS

Out of the 103 different manufacturing operations and inspections necessary to the production of finished Axelson Liners these views have been selected to illustrate definite factors. First, these candid views are indicative of complete engineering and manufacturing facilities—second, they express Axelson's painstaking attention to details—third, they exemplify the metallurgical research, the laboratory control and the constant testing carried on as a part of all Axelson Liner manufacturing.

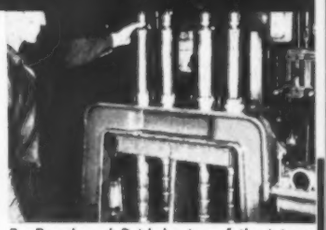
Axelson Liner processes shown are on the regular cast iron only, but Axelson Liners are also available in hardened cast iron, Super-cast iron, Nitri-cast iron and hardened steel Super-Service types. In each will be found design, construction and metallurgical features that make Axelson Liners the oil industry's best buy.

1. Sand molds for liner castings are produced from accurate patterns. Prior to actual pouring operations the previously made cores are placed in the liner molds.

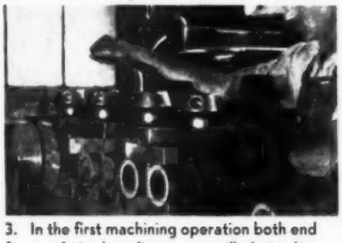


2. Internal strains set up in casting Axelson liners are relieved by a normalizing treatment involving the placing of the castings in automatically controlled electric furnaces.

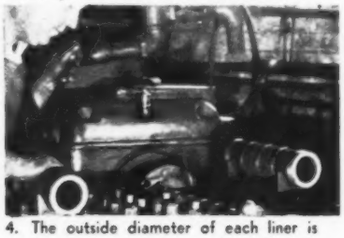
6. High hydraulic pressures are used in testing Axelson liners for any possible porosity. This equipment is designed and built to Axelson specifications.



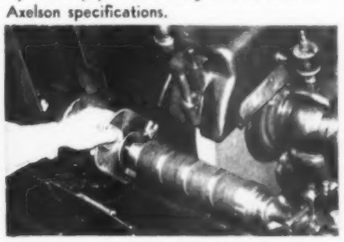
7. Rough and finish honing of the interna surface of Axelson liners produces not onl a high polish but establishes a definite siz to A. P. I. specifications.



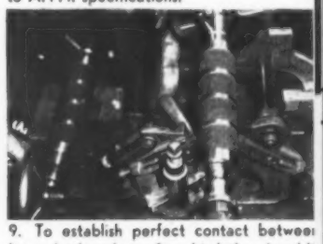
3. In the first machining operation both end faces of Axelson liners are milled simultaneously in specially tooled duplex milling machines.



4. The outside diameter of each liner is machined to a predetermined size for subsequent grinding. This operation is performed in special lathes.



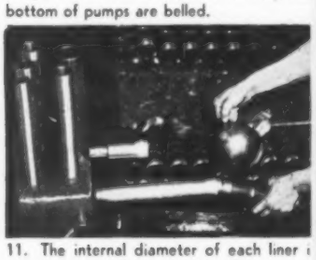
8. The previously turned outside diameter of each liner is now ground to finished size and predetermined tolerances.



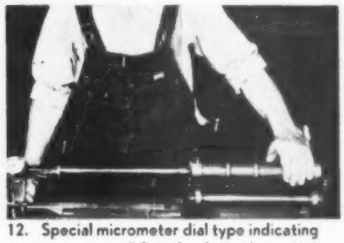
9. To establish perfect contact betwee liners, both ends are faced in lathes. In addi tion, the liners to be used at the top an bottom of pumps are belled.

5. The internal machining of Axelson liners involves, among others, rough, semi-finish and finish boring operations. For this work special fixtures are used to insure maximum accuracy.

10. The corners between bore and end faces are slightly rounded to avoid sharp edges on the finished liners.



11. The internal diameter of each liner checked with "Go" and "No Go" gauge to verify correctness of machine operations Visual inspection is made on inside surfaces



12. Special micrometer dial type indicating gauges are used for checking the entire inside surface for roundness and concentricity with its outside throughout its length.

13. End faces are checked for smoothness with thumb and squareness by using a straight edge in conjunction with a specially lighted background.

14. The liners are cleaned in vapor-type de-greasing equipment and are immersion-coated with a rust-preventive solution.

15. Liners are either boxed for immediate shipment or placed in indexed storage for ultimate pump assembly.

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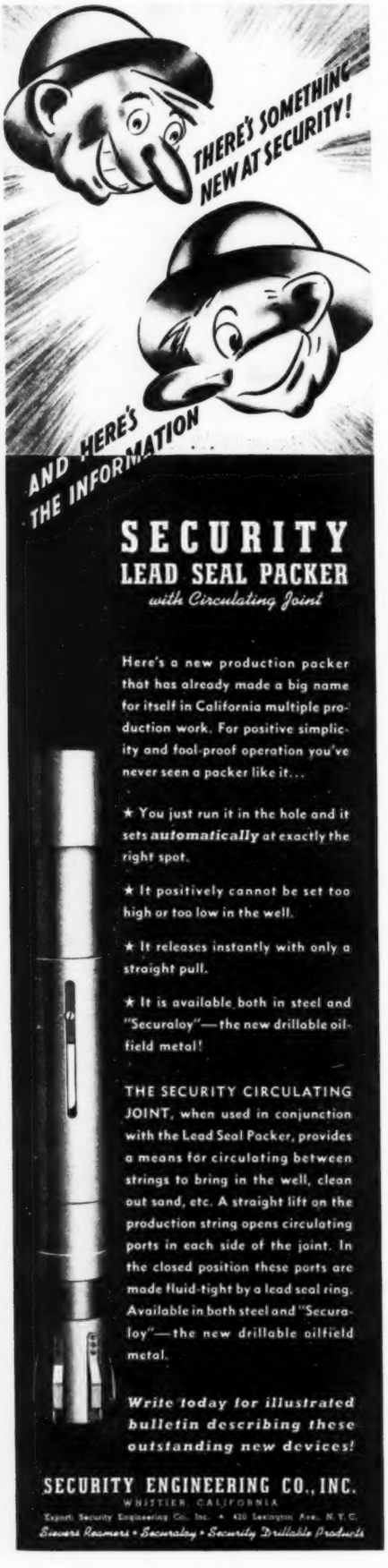
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For instance, in 1930 the Soviets exported 1,340,000 tons and restricted the domestic consumption to 305,000 tons. In 1933 gasoline exports only exceeded domestic consumption by approximately 150,000 tons, whereas last year exports were down to 350,000 tons and domestic consumption jumped to 4,500,000 tons. These figures give a clue to the changing conditions in the Soviet Republic.

Exports of U.S.S.R. Petroleum Products

	June		Jan.-June	
	1937	1938	1937	1938
	(long tons)		(long tons)	
Lubricating Oils...	15,966	6,765	116,904	52,560
Fuel Oils.....	88,826	19,724	482,882	148,203
Kerosene.....	11,693	Not Available	110,447	13,670
Gasoline.....	50,980	37,061	258,852	117,847
	167,465	63,550	969,085	332,280

According to the U.S. Department of Commerce, exports of petroleum products from Russia's Black Sea ports during the first six months of 1938 were down to 332,280 long tons, as compared with 969,085 tons in the corresponding period of last year, a decline of 62 percent.

Of the crude production in 1937, only 28,500,000 tons were run to stills. Of this quantity 21,000,000 tons were Baku crude. Its gasoline yield was 1,100,000 tons, or only 5 percent. Grozni produced 3,500,000 tons which gave a gasoline yield of 900,000 tons, or 25 percent. Maikop crude gave the best gasoline results, namely, 35 percent; of 1,600,000 tons, 600,000 tons of gasoline were manufactured. All others had a 15 percent gasoline yield, producing 400,000 tons. In addition, various cracking plants produced 1,500,000 tons making a total output of gasoline of 4,500,000 tons.

July crude production in all Soviet oilfields was slightly below the output for June, regardless of the fact that during the first half of the month operations actually ran as high as four percent above plan. The downward trend during the latter part of the month spoiled the gain made up to that time. Lower output from the Baku oilfields was mainly responsible; Grozni, Maikop and Emba oilfields being successful in keeping above their quota. All Soviet oilfields combined only produced a little over 96 percent of their quota for the month.

The Russian program for reopening about 2,500 shutdown wells during 1938 has not made the progress expected, due to causes which have consistently hampered Soviet oilfields expansion for many years past, namely, lack of equipment and shortage of skilled labor.

In their efforts to meet the production quotas fixed by the authorities the Soviet oilfield operators prefer to concentrate on wells which give a promise of flush production. Consequently, they neglect a large number of small producers which have

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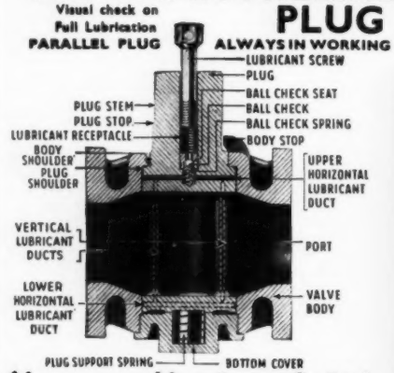

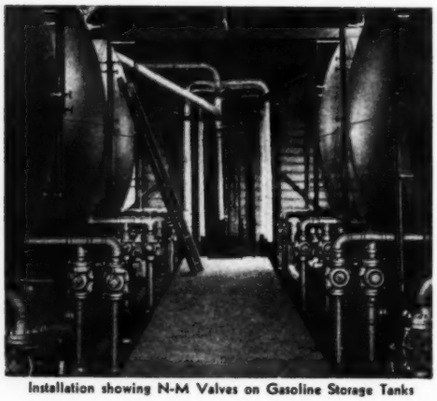

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been shut-down and abandoned in order to use the equipment and pipe for more promising wells.

While between 1935 and 1937 the number of all Soviet wells in operation increased to 7,500, or a gain of 2,300, the number of shut-down wells grew to 2,500. Orders were given to reopen 2,300 wells during the first six months of 1938 of which 1,170 wells were to be at Baku. Regardless of the fact that special regulations were made and special supervisors appointed, only 502 wells were reopened up to June 30th.

The authorities are inclined to look upon the operations as a new form of sabotage, the basic idea of which is to discredit the reopening of abandoned wells as too costly and promising little improvement.

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Mexico Pushing Oil Sales

WHILE diplomatic interchanges between the United States and Mexico have been sidetracked temporarily by the discussion over the seizure of American-owned lands, representatives of the Mexican government have redoubled their efforts to find export outlets for oil. Reports of direct negotiations for the barter sale of large quantities to Germany were supported by the sudden return to Berlin of the German Ambassador to Mexico, allegedly to discuss such an exchange. Efforts of Mexican agents to effect sales to Latin American countries appear to have had only meagre results but renewed attempts to do business with Italy and Japan are reported and it is stated that the Mexicans have offered to cut current export prices of the United States and Venezuela.

A statement by W. R. Davis early in August revealed that from May 10th to that time his company had shipped a total of 2,408,960 bbl. including the following quantities:

Destination	Bbl.
United States (New Orleans)	400,000
Scandinavian countries	320,000
France	240,000
Italy	190,000
Poland	90,000
England	250,000
Germany (Europaesche Tanklager Refinery)	940,990

Payments for oil delivered, according to this statement, included $1,087,360 in cash and equipment credits of $1,414,838. This was part of the 10,000,000 bbl. covered by the Davis contract of last April.

In view of the weakness of the crude price structure in the United States, considerable concern was caused by the announcement during August of the sale of 100,000 bbl. to Eastern States Petroleum Company for refining at Houston, Texas. This was reported to be only part of a larger quantity expected to follow the same course.